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REPORT OF COMMITTEE

ON

DISPOSAL OF WASTE AND GARBAGE,

PRESENTED AT THE NINETEENTH ANNUAL MEETING OF THE
AMERICAN PUBLIC HEALTH ASSOCIATION, KANSAS
CITY, OCTOBER 20–23, 1891.

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REPORT OF COMMITTEE ON DISPOSAL OF WASTE AND GARBAGE.

SUMMARY.

1. *Résumé of Work Being Done. Professor Delos Fall, Chairman of Committee, Albion, Mich.*
2. *Appendix* (a). *Proposed Forms of Ordinances.* (*Received too late for publication.*)
3. *Appendix* (b). *Collection and Transportation of Garbage and Refuse in Cities. Edward Clark, M. D., Buffalo, N. Y.*
4. *Appendix* (c). *Collection and Transportation of Garbage. Col. W. F. Morse, New York.*
5. *Appendix* (d). *Tabulated Reports of Health Officers.*

METHODS OF DISPOSAL.

6. *Appendix* (e). *The Merz or Vienna System described. Edward Clark, M. D., Buffalo, N. Y.*
7. *Appendix* (f). *The Rider Garbage Furnace described. Crosby Gray, Pittsburgh, Pa.*
8. *Appendix* (g). *The Engle System described. Col. W. F. Morse, New York City.*
9. *Appendix* (h). *Crematories used in England described. Rudolph Hering, C. E., New York City.*

Résumé of Work Being Done.

The Committee on the Disposal of Waste and Garbage was constituted at the Memphis meeting, 1887, and, under the chairmanship of Dr. S. S. Kilvington, of Minneapolis, made two valuable reports, which are published as parts of the proceedings of this Association at its meetings held in Milwaukee and Brooklyn. These reports form an important part of the present discussion, and should be referred to for a complete study of the question.

The present committee has held two meetings before coming to this annual session of the Association, one at Pittsburgh, Pa., at which time the Rider Garbage Furnace was visited and studied, and at which meeting the general plan of the conduct of the work was outlined and adopted. The second meeting was at St. Louis, Mo., where the new plant of the Merz Extractor and Construction Company was studied and a part of this report was prepared. The work has been organized and divided among the different members of the committee for special study. Some members of the committee have done their work; others have not.

In making the present report, there will, no doubt, be the repetition of some familiar and oft expressed facts; and still, in this question, as in others, iteration and reiteration may be needful in bringing about a reform already too long delayed. The dangers are real; the victims due to neglect of this important question fall on every hand. Heaps of garbage continue to be disease-breeders, furnishing the proper conditions for the rapid growth and development of any disease germs which may lodge therein.

The processes of putrefaction and decay are better known to-day than formerly: these do not consist of mere oxidation, but in large part are due to the action of the bacteria of putrefaction and fermentation. Where these ordinary bacteria thrive, pathogenic germs may, and hence it follows that garbage accumulations are a constant menace to the public health. Forgetful of the well known biological law, that all living beings, including man, produce excretions which are poisonous to themselves, he still goes on accumulating masses of such excrementitious matters, until the earth, water, and the very air is charged with death-producing elements, afflicting not alone himself, but his family, the neighborhood, the entire community, or even the large city,—sometimes, by the carelessness of a single person, spreading disease broadcast over the whole land.

The problem is not different in kind, but only in degree, whether man is closely huddled together in the densest populated portions of a great city, or dwells apart from his fellows in the small village or country place. Serious harm may come to him in either case, if only some one is careless in regard to the proper care and disposal of his waste and garbage.

The excreta from a single person in Plymouth, Pa., contaminates the water-supply, and a city of eight thousand inhabitants is thrown into sorrow and distress;—1,153 persons, a large proportion of these being from the adult population, were sick, 114 of these died, and an expense incurred amounting in the aggregate to over $97,000. A method was adopted by which wastes from an iron mine in Negaunee, Mich., could be easily disposed of, a method which at this distance and in this presence seems monstrous, that of allowing these wastes to flow into the lake from which the city derives its water-supply, and the city is plunged into an epidemic of typhoid fever, long continued, death producing, and a reputation gained by the city which does not advertise it most favorably, at least not as a health resort. Forty thousand people in the United States die every year from typhoid fever. For every person who dies with this disease at least ten are sick; so there are sick in the United States every year from this one disease, on the average, 400,000 people. For every person that is sick, the time and attention of at least one other person is demanded, either as nurse or otherwise; then 800,000 in the United States each year are either suffering from, or attending those who are suffering from, this disease. You may go further in the computation. The average duration of this disease is about twenty-eight days, or in the aggregate 22,400,000 days. If money considerations could ever be placed alongside the value of human life, an easy estimate, at say one dollar a day for each of these, would show the financial aspect of the case to be something very serious indeed. This from one disease. Add to this the large number of other filth diseases with their attendant sickness and death, and the problem before us for study at this time stands out in all its gigantic proportions.

THE GROUND COVERED BY THE REPORT.

The present report is one merely of progress, many points which have been raised not having as yet been discussed in any adequate manner. Progress has been made, and valuable material gathered, all of which will be handed over to the committee that shall be appointed at this meeting to continue with the work.

We are endeavoring to study over the entire ground,—from the case as it presents itself in the smaller town, to that of the metropolis; from the stand-point of the householder, merchant, and manufacturer, as well as from that of the municipal corporations in whose hands the successful accomplishment of the work finally rests; from the stand-point of those towns and cities which have a well established water-supply system with its accompanying sewers, to those unprovided with these appliances, and which are still depending upon private wells for their water-supply.

We have desired that those who are personally and pecuniarily interested in methods of final disposal should have a hearing, and an opportunity to establish their claims to the best solution of the problem; and at the same time we have desired that the people should be thoroughly protected as against the expenditure of public money invested in schemes which will inevitably result in failure to accomplish the desired end.

The report emphasizes the following features of the subject:

1. As primary to all other considerations, there should be the education and enlightenment of the people with reference to the dangers arising from the neglect of this question.

The committee, in their investigations, have become deeply impressed with the wide-spread indifference which still prevails regarding this subject, and they call on true sanitarians everywhere to use all their influence in moulding a healthy public sentiment which shall speedily work reform in this direction.

The people must be taught that the public health is not a thing to be tampered with. Reckless individuals must not be permitted to jeopardize their own and their fellow-citizens' lives by carelessness in the midst of disease-producing conditions. The committee urge the holding of frequent sanitary conventions, carried on by the state and local boards of health, in which careful instruction shall be given regarding the house and its surroundings, the relation of filth to disease, of the well to the the privy vault, of the house to the cesspool, etc., and of all these to contagious and communicable diseases. In large cities the public press ought to be teachers along these lines.

We do not go so far as Thomas Carlyle, who declared that every sick man was a rascal, but we do assert that there would not be as many deaths from communicable diseases if there were not some rascality or ignorance somewhere; and this rascality and ignorance rest with the whole people,—a people who will spend thousands of dollars to maintain a standing army to protect us against foes with whom we ought to be at peace, and a pittance of twenty-five or fifty dollars per year as salary of a health officer to protect us against this army of disease germs; a people who will spend hundreds of thousands of dollars to protect the lives of fishes, and a hundred dollars to protect the lives of men, women, and children; a people who will spend thousands of dollars to maintain a fire department to protect our property, and will give the "sanitary fire department" a hundred dollars to protect the lives of the citizens of the state. This phase of the subject is emphasized in a paper by Dr. Edward Clark of this committee, which paper forms a part of this report.

2. The mayor and common council of the cities, the presidents and trustees of villages, local boards of health and health officers, prosecuting attorneys and the police, all have important relations to this question. These responsibilities they should feel and know, because of their intelligent study of the subject in all its bearings. Two courses are open to these parties: Either, they must inform themselves, and by their intimate knowledge of the subject be able to legislate for themselves, or they must place the whole management of these and kindred subjects in the hands of a well paid, enthusiastic, educated health officer, who shall have full control, with proper ordinances to enforce his views, with full and sufficient penalties for the violation of the law, and with the moral and financial backing of the officers of the law, without which his work will fail. In the opinion of the committee, the health officer, acting as the executive of a small but thoroughly informed and progressive health board, is the proper person who should have this power placed in his hands, and he should be held strictly responsible for thorough and effective work in this direction. Mayors and aldermen, as a rule, will not inform themselves properly. They are too busy in the administration of the financial matters pertaining to the city which they serve—matters which seem to them to overshadow mere considerations of public health. In all communities may be found from three to five public-spirited, well informed, intelligent sanitarians, who will be willing to devote time and labor in the capacity of a board of health. It goes without saying, that these men should be sought out and appointed from their peculiar fitness for the tasks they are to perform, and not from any considerations of party affiliations, or political beliefs.

3. The committee have thought that it would be helpful to those dealing practically with this subject, if some forms of ordinances should be suggested, which in a general way should serve as a model for cities which have not already formulated and adopted such rules and regulations. These proposed ordinances, bearing simply upon one phase of the subject, may be found in the appendix to this report. It follows as a matter of course, that in many respects these regulations would necessarily be modi-

fied to suit the particular needs of the particular communities adopting them. Suggestions for ordinances bearing on the collection and disposal of garbage, other than night-soil, will be found in Dr. Clark's paper on the collection and transportation of waste and garbage, which is also to be found in the appendix to this report.

By way of comment on this part of the report, the committee desire to say that, in their opinion, this body, the American Public Health Association, should raise its voice emphatically against the perpetuation of the old-fashioned, deep privy vault system, and the traditional earth-storage system. If it is necessary that a privy-vault be used, it should never be of greater depth than two feet, and should frequently be cleaned. Other than these should be completely abolished, not alone in those cities which by their sewer systems may conduct human excreta into the same, and so remove them from immediate power to produce mischief, but this reform should be carried into all villages and farming communities. The evils arising from the lack of attention to this are not confined to large and densely populated cities, although in such places the evil is greatest: the small village and hamlet, the country residence even, may give rise to serious epidemics due to lack of care in this direction. It is not too much to hope that one of the early results reached through the influence of sanitarians shall be that this plague spot, this relic of barbarism, shall be utterly wiped off the face of the earth. It certainly requires no argument to prove the objectionable features of the ground-storage system. In a city fifty years or more old and containing a population closely packed together, each four rods by six or eight, it may be, has its dwelling-house, and, accompanying it, a privy vault, cesspool, barn, and well, the former of these accompaniments reeking with their filth and odorous from decomposing excrementitious matters. The deep privy vault is a barbarous thing even in the country, with six or eight families or from twenty-five to forty persons to the square mile of territory: how much more objectionable when two or three thousand people occupy less than this amount of space, all depositing the waste of their bodies in the soil, often in close proximity to the well. An eminent sanitarian says that vaults and cesspools are accountable for nineteen twentieths of all cases of typhoid fever; and adds as his opinion, that "if the dry-earth system were adopted, typhoid fever, cholera, and other filth diseases would speedily disappear."

"Forty-two deaths from infantile diarrhœa in June. These deaths occurred in forty houses. It appears that all have privy vaults save two, and many of these houses were supplied with water from wells in close proximity to the cesspools and privy vaults."[1] Comment is unnecessary: "he who runs may read."

We may study to advantage some of the model by-laws of local government boards of cities in England which pertain to cesspools. One of these requires that cesspools must be at least fifty feet away from the dwelling. It must have no communication whatever with the drain from the house (the attestations of makers and advocates of patent sewer-traps to the contrary notwithstanding), its walls and floors must be constructed of good brick-work in cement, thoroughly cemented inside, and with a backing of well packed clay of at least nine inches. Around and beneath the brick-work, the top of the cesspool must be arched over, and means of ventilation provided. Constructed in accordance with these principles, they are far superior to the practice of emptying liquid and semi-solid waste matters into the earth, quickly to make their way through the soil and into the well. It is, however, bad practice to store such material for any length of time in any receptacle, there to putrefy and generate noxious gases. They should be emptied frequently.

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[1] Annals of Hygiene.

4. The fourth point which the committee desire to enforce is that by which correct methods are arrived at concerning the collection and preservation of garbage by householders, hotel keepers, etc., and the transportation of the same to the place of final disposal. Much of the annoyance complained of by the people, many of the nuisances, have arisen from the careless and imperfect manner in which garbage has been allowed to accumulate about the premises, the unsightly, foul-smelling receptacles used, and the open carts and wagons dropping their refuse along the way, and presenting to the eye that which is offensive in the extreme. These questions are discussed by Dr. Clark, and also by Colonel W. F. Morse.

5. As fundamental to the discussion of the practical handling of garbage, the committee found it necessary to have a common understanding in regard to the classification of material which should be regarded as garbage, and to which our study should be confined. An enumeration of these materials would include ashes, street sweepings, kitchen refuse from hotels and private houses, manufacturers' refuse, fruits, vegetables, etc., from groceries; manure, dead animals, night-soil, tin cans, bottles, etc. These wastes may be classified into (1) inorganic and (2) organic. Of the inorganic wastes may be mentioned ashes, street sweepings, certain forms of manufacturing refuse, tin cans, bottles, etc. The organic wastes include the vegetable wastes from private houses, hotels, and groceries, certain forms of manufacturers' refuse, the ordure of animals, the excretions of man, and dead animals.

As ordinarily used, and therefore as used in this discussion, the term garbage includes simply vegetable wastes, such as refuse from groceries, the kitchen, etc.; the term animal waste includes the ordure of animals, and the solid excretions from man; wastes from manufacturing establishments, and all inorganic wastes, may be included under the term refuse.

WHAT IS BEING DONE.

The committee have endeavored to obtain fresh and reliable information in regard to methods now in operation in the larger cities. To this end the following circular was sent to one hundred of the largest cities in the Union:

City of . . . . *1891.*

Report by . . . . *Official position* . . . .

1. Method employed for the disposal of garbage,

(a) Street sweepings . . . .

(b) Ashes . . . .

(c) Refuse from stores, manufacturing establishments, etc. . . . .

. . . .

(d) Refuse from hotels . . . .

(e) Night-soil (if run into sewers, state where sewers empty) . . . .

. . . .

2. Does the city own the appliances for doing the work, and what was their original cost?

(a) Cremating or reduction works . . . .

(b) Horses, carts, etc. . . . .

(c) Cost of maintenance . . . .

3. Is the garbage brought to the place of final disposal at public or private expense? . .

. . . .

4. On what kind of wagons is the garbage collected and conveyed to the place of disposal? . . . .

5. What is the cost, per mile, of collection and conveyance? . . . .

6. How much material is gathered daily? . . . .

7. What, in your opinion, would be the bulk of the waste matters, per inhabitant, if this work were thoroughly done? . . . .

. . . .

8. Is the matter of collecting waste and garbage made obligatory upon house-holders, store- and hotel-keepers, manufactures, etc.? . . . .

9. What parts of the garbage possess value, and in what form are they sold? . . . . .

. . . .

10. Where is the place of final disposal? . - . . . .

11. Have any nuisances arisen from this work, and if so, in what regard? . . . . . .

. . . .

12. How are the men engaged in this work appointed or hired? . . . .

. . . .

13. How can this branch of the public health service be improved? . . . .

. . . .

[*Use the back of this sheet for fuller replies, or other suggestions.*]

Replies were received from thirty-seven of these, but it would seem that owing to the form of the questions, lack of space on the blank for appropriate replies, or for other reasons, the replies are somewhat meagre.

For example, question 5, as to the cost per mile of collection and conveyance, received scarcely a reply. This is an important consideration, for until some method is devised by which garbage can be disposed of in the centre of the city, without creating a nuisance and giving offence, the garbage must be removed to some place outside the city limits, and the method which will do this work most expeditiously and most cheaply, is the method which will find favor. Scarcely any of the health officers sending replies could give any reliable estimate of the amount of garbage per inhabitant necessary to be cared for, if the work were thoroughly done. These two are mentioned, with their discouraging answers or lack of answers, to indicate how far we are from possessing such facts and figures, such statistics, as will make it possible to study the question in a scientific manner and from the economic stand-point. The replies which are received have been tabulated, and are presented in connection with this report, marked "Appendix C."

Taking a brief survey of the largest cities of our country, the facts are as follows, as showing what is being done toward the solution of this question :

In New York city the disposal of waste and garbage is not under the direction of the board of health at all, but the bureau of street-cleaning has entire charge of the work. The garbage and refuse are collected by the city teams, loaded upon flat-boats, removed to the sea, and dumped.

From the extremely business-like report of the general sanitary officer of the city of Chicago for 1890, we make the following extracts : The total cost of the scavenger service, from January 1, 1890, to December 31, 1890, was $253,140.72, for the thirty-four wards of the city, covering an area of 174 square miles, embracing 2,047 miles of streets, and about 3,000 miles of alleys. The service, as a whole, has been fair, but not an ideal scavenger service by any means. Outside of the first ward, which has had daily service, not to exceed a triweekly service has been performed. About 225 teams have been regularly employed by contractor and city, removing on an average 2,000 cubic yards of refuse per day : this refuse has been deposited in clay holes, removed by train beyond the city limits, and during the life of the "Chicago Garbage Reduction Co." (a private corporation), from February 19 to October 15, 1890, 7,208 tons of garbage were burned—thirty tons per day.

In the city of Chicago, from a careful estimate, there are at least 100,000 horses, making an average of 750 tons of manure every twenty-four hours (this does not include the stock-yards). This amount is not removed daily, of this fact I am well assured, nor will it be until manure becomes a commodity, not alone a fertilizer, but as a fuel. Our growth as a city, the gathering of a denser population, and the occupancy of the entire lot with buildings, will naturally tend to this. Manure, in all European and in many of our older cities, has a fixed value : it is carefully collected, baled, and stored until needed for a fertilizer or for fuel, then it becomes the old story of "supply and demand." The baling of manure is the ideal manner of its disposal. The packages are clean, giving off no odors. It is easily stored without a sacrifice of valuable space, is economically handled, and its transportation by wagon or rail is obnoxious in no particular to the most fastidious. The total number of dead animals removed during the year, as shown by the secretary's report, was 24,419 (this does not include the stock-yards). The work has been faithfully performed,—sometimes, during the summer months, not as expeditiously as this department or interested citizens demanded, but as quick as humans, working day and night during the "hot wave" of July, could handle these putrid carcasses. The gathering of dead animals is not a profession or calling that most men are fitted for. I have tried it. I know it takes a stomach of iron, a total lack of the sense of smell, and the hauteur of a Sioux Indian to stand the repartee of the street gamin. Few men like it. I do not blame them. This is the reason, that, when it appears as if the department must have extra teams and actually need them, and have money ready to pay for them, you cannot, even in this great city, find the men who can or will collect dead animals. The animals are all removed beyond the limits of the city, and rendered.

The department secretary issued during the year 8,737 permits to clean vaults, and a conservative estimate bases the number of cubic yards removed at 21,843. The old-fashioned privy-vault, built in the yard in the rear of a building, is becoming, in progressive communities, a thing of the past. Still we find the old fogy who does not want improved water-closets in his house; and for many years to come, especially in the older portions of the city, this department will have the vault question to contend with. Permits must be granted, and some method must be employed so that this department will know positively where each load goes.

Philadelphia reports as follows:

> The present system of collection and disposal of garbage has been tried for a long time, and has proved a failure, from the sanitary point of view. The garbage is removed, by a number of small contractors, in a very unsatisfactory manner. Many of these contractors dispose of it by feeding it to hogs, others mix it with other waste products for manure, and at times it is buried, or accumulated on the ground, awaiting slow decomposition. There is no longer any doubt as to the remedy, or rather the prevention, of these multifarious nuisances. It is cremation. A large number of cities and towns, here and abroad, are now employing this means of disposal of garbage with the most satisfactory results. It has everything to recommend it. It is economical, prompt, efficient, inoffensive, and completely sweeps out of existence offensive nuisances which harass communities that employ the old plan. The use of refuse for filling up sunken lots for building-sites is to be condemned, for the best of reasons. Dwellings built upon such soil cannot be healthful, and yet depressions are scarcely levelled with this heterogeneous mass before the builder commences his work of erecting houses.

From the Brooklyn report of 1888 the following information is gleaned:

> Garbage and refuse removed to sea. Collections made from hotels daily, and from houses twice a week in winter, and three times a week in summer.
>
> The disposal of stable manure has been a serious question with us, owing to the great number of horses employed in Brooklyn, somewhere in the vicinity of 26,000, mak-

ing, at a low estimate, some 182 net tons of droppings, which, with the particles of straw intermingled, brings the quantity up in the neighborhood of 200 tons daily. In the early spring the neighboring farmers removed it promptly, but as summer advanced the farmers, occupied in attending and marketing their crops, had no time, and its shipment in bulk was interfered with for like reasons. To enforce the ordinances under these conditions was impossible, practically. It was then suggested that experiments be tried to bale it, like hay and straw. A series of experiments, continuing from early spring until recently, was made under the directions of Dr. d'Homerque, and the result has demonstrated that when it was taken fresh and thrown into the box of the press until that was filled, and the bale stick and wires from the bales of hay or straw were used, the cost and time were, in large stables, not more than that of carting it to the manure pile. The cost of purchasing stick and wire was four and one half cents per bale. The advantages of this method are,—(1) reducing bulk into compact space; (2) preventing fermentation or fire-fanging, by reason of the compression, thereby enhancing its value as a fertilizer by retaining the ammonia; (3) the permitting its removal and shipment causing offence.

St. Louis report, 1889:

The former and existing methods of disposal of garbage, dead animals, and night-soil (where no sewers exist), are not such as meet the wants of our increased growth and advanced condition. The present mode of collecting the refuse from all portions of our territory, and conveying it to a few dumps and there discharging it, is very objectionable. A nuisance is created, and maintained by hauling offensive materials over the streets, and disease is engendered by dumping it into the river at its banks, where it is likely to lie or float a short distance, and lodge in greater or less quantities. This statement applies also to the night-soil removed from vaults in that portion of the city where sewers have not been constructed.

Dead animals are collected from all parts of the city, and hauled through the streets and across the river to a rendering establishment in Illinois. How long permission may be given for taking the carcasses of these animals to the locality where they are now disposed of, is a matter of great uncertainty, and is a question that might confront the municipal authorities at some very unexpected time, when they are least prepared to deal with it. The disposition of garbage and refuse material of cities is now receiving the attention and earnest consideration of sanitarians everywhere. Enlightened communities are earnest in their endeavors to determine the best method of preserving public health, by the most effective and economical destruction of filth accumulations. Of late years there have been constructed a number of crematories or furnaces, and extractors, in different cities, attended with varying success. Some of these aim at the destruction by fire in the easiest manner; others, looking at the commercial value as well as the final disposition, claim to be able to dispose of them by inoffensive and sanitary methods, and at the same time utilize their products. This subject is one that should now be taken into consideration by the authorities of this city, and if the matter is found practicable, the disposition of the dead animals as well as the garbage and night-soil (that has to be removed from vaults) should all be done at the same place, or at places set apart for that purpose. There has not yet been sufficient information obtained here concerning the latest process in use to give a definite idea of the best method to be pursued for the accomplishment of this important work; nor can that information be properly obtained without a personal inspection of the process in operation. Such observations should be made at the earliest day practicable.

This in 1889. Since that time a contract has been entered into with the Merz Extractor and Construction Co., this company agreeing to dispose of two hundred tons per day at ——— per ton; and of all gathered above that amount, free of cost.

Boston:

There are now about 350,000 loads of garbage, ashes, street-sweepings, and other miscellaneous débris gathered up by the city teams annually, and carted away to different places and for different purposes. The annual cost to the city in hauling this large amount of material is about $500,000, more than $100,000 of which is spent in collecting garbage. With the growth of the city, and the gradually increased distance to which such matter must be carried for disposal, comes a corresponding increase in the expense. The question occurs to us, Cannot this growing expense be lessened, and much of the offence now attending the necessary storage of garbage in the houses and yards, and the hauling and carting of it in the streets, be avoided? It is found that with trifling cost in arranging the kitchen stove, each family can easily burn all its refuse as it is made and before it becomes offensive, and thus save all subsequent expenses and nuisances incidental to its being kept on the premises for several days and then carried through the streets by the city teams.

Baltimore:

The present mode of disposing of the garbage, night-soil, and street dirt of the city, as at present carried on, though far from perfect, is, with our present facilities, the best our circumstances will allow. The offal and filth of cities must be deposited somewhere when gathered from every house and locality, and is, from the very nature of things, a nuisance to those who reside in the neigborhood of the dumps. Much, however, could be done in mitigation of this evil by more stringent regulations in the manner of removing both garbage, ashes, and night-soil. The garbage carts are very poorly adapted, in their present construction, for the transportation of garbage and ashes through the streets of the city, and are a source of constant complaint by citizens whose olfactories are greeted throughout the summer months by the odor of decaying vegetable and animal matter, and at all seasons saluted by a shower of dust from uncovered ash-carts.

San Francisco settles the garbage question for 297,990 people in a very few words:

The proper disposition of the city's garbage should be promptly attended to. Many cities of Europe and the East have their garbage consumed in furnaces, it being found to be the cheapest and most expeditious manner of its disposal. I would, therefore, recommend that proper furnaces be built, and the garbage of the city be burned therein.

Cincinnati, the ninth city of the Union, with her 296,309 people, has the following to say:

On January 31, 1883, the city of Cincinnati entered into an agreement with the Cincinnati Desiccating Co., for a period of ten years, for the sum of $2,500 per annum, to perform the following work: to remove all vegetable garbage, dead animals, and slaughter-house offal which may accumulate within the corporate limits of the city of Cincinnati; and they further agree to pay the owners of dead hogs removed a price per hundred weight not less than one third of the value per hundred weight of live hogs of like weight and quality; and they further agree to pay the owners of dead cattle removed from three to ten dollars per head, according to weight and quality; and they further agree to pay the owners of dead sheep from twenty-five to seventy-five cents per head, according to condition and quality. They further agree to remove all animal offal from slaughter-houses and kitchens, within the limits of the city of Cincinnati; the price to be paid therefor to the owners thereof to be subject to the agreement between said owners and the Desiccating Co.; further, they agree to remove all dead horses, mules, dogs, etc., found within the city limits of Cincinnati. They agree to gather and remove all animal matter from private dwellings, boarding-houses, and hotels, at least three times a week, and all slaughter-house offal daily. Vegetable garbage, or offal, to mean kitchen vegetable matter unmixed with ashes or other refuse matter. Animal garbage, or offal, to mean soap-grease from dwellings, boarding-houses, hotels, and steamboats. Slaughter-house offal to mean the entrails and plucks of slaughtered animals, and tank stuff. Carcasses and dead animals to mean animals dying from disease or accident, and not to mean animals slaughtered for human food.

Cleveland :

A long delayed sanitary necessity remains unprovided in this city, to wit, a satisfactory gathering of house-garbage. No city of this size can be considered well taken care of which makes no public provision for this purpose. Private methods are entirely inadequate, and mainly efficient for the prompt and cleanly removal of such material. It is an old topic in these reports, but must continue to be urged until some relief is obtained. Whatever disposition is finally made of garbage, a systematic gathering should be inaugurated as speedily as possible. At present we are without funds for such service, but could money be better employed for the real welfare of our citizens?

Charleston :

For the past ten years the city of Charleston has, under the direction of the board of health, removed the garbage of the city. The carts, under the direction of a superintendent, leave the stables at six o'clock every morning. They are engaged in removing garbage until it is all removed. This is usually accomplished by noon. Every household is required by ordinance to put out in front of their doors, every morning, the garbage accruing on the premises. This is done every day in the year except Sundays. It has worked most satisfactorily. The authorities have entire and complete control of the carts. The drivers are held to a very strict account for their specified routes. The garbage is hauled to out-lying marsh lands to which salt water has flow every day. We have had no sickness in these sections. As to the cost. From noon until dark the carts are engaged in city work. These thirty-five carts do an immense amount of work for the city. I have stated the cost at $19,000 or $20,000. This is the total. Deducting about $10,000 for city work, the real cost for removing garbage is about $10,000. You can readily see what an advantage this method secures, at a minimum cost. We get all the work the carts can do, and there are no contractors in the business. It allows us to concentrate at a moment, as occasion necessitates. The streets of Charleston are kept exceptionally clean. We have been paving our streets with stone road-beds, Belgian blocks, for the past ten years, and the carts have been of great assistance.

Milwaukee :

The garbage (animal and vegetable matter from the table and kitchen) in this city is kept entirely free from street-sweepings, ashes, and other refuse. The city collects all animal and vegetable matter from the private houses, hotels, and restaurants only. The work is done by men employed by the city by the day. The cost last year of collecting was $23,316; the cost of disposal last year was $15,500. The disposal was by a company which had a contract with the city for three years, said company using the Merz or Vienna process. The contract has now expired, and the law requires that the common council shall enter into a contract for the disposal of the garbage,—and the matter is now before the council for consideration, and has been all summer. The Merz process was satisfactory to this department, but its location and management were not satisfactory, and a prejudice has been created against it, so that it is doubtful if that process will be used in the immediate future. At the present time the garbage is being dumped into Lake Michigan, much to the disgust of this department as well as to many citizens, but this, it is hoped, is only a temporary expedient. The street-sweepings and ashes are used at the present time for filling purposes on low land. Night-soil that is deposited in water-closets runs into the sewers, the sewers empty into the Milwaukee river, which is flushed out into Lake Michigan—another proceeding not approved by this department. Night-soil deposited in privy-vaults, of which there are about 20,000 in the city, is removed by scavengers to the adjoining farm-lands near the city.

Garbage is collected in wooden wagons provided by the men who collect it, which is not approved by this department. The amount of garbage daily collected at the present time amounts to about fifty tons. Commission merchants, fruit dealers, grocers, etc., are obliged to remove their own garbage.

In regard to question 13—"How can this branch of the public health service be improved?" I would state that I believe that air-tight steel carts should be adopted for collection, that collectors should be hired by the city by the day and not by contract, that the collection should be under the control of the health department and by an officer possessing full police powers; that in the summer-time the garbage should be collected daily, preferably in the early morning hours, and in the colder months as often as twice a week; that a garbage plant should be owned and managed by the city government, and should be located on land condemned by the city, outside of the thickly populated part of the city; that if the city is over 100,000 in population, one plant for every 75,000 or 100,000 population should be provided, so that too large a business of this kind would not be conducted in the same locality. As to the methods of destruction, I believe the Merz or Vienna process the best and most economical ever yet devised for taking care of the garbage of 100,000 inhabitants or more. The only other scientific process with which I am acquainted, that promises anything, is cremation, and I have yet to see the plant, and I have seen quite a number, where the gases can be consumed and where the plant can be run without producing a greater nuisance than the Merz process. The Merz process has the advantage of converting the material into more or less valuable products in a commercial point of view, while cremation destroys everything except obnoxious gases. As a member of the American Public Health Association, I am decidedly opposed to your committee's rendering a final report on this subject the present year, for I believe improvements will be made within a very short time now, which will be of great value to citizens, and I believe the subject should remain open and that a report of progress only should be made.

District of Columbia:

The Collection of Garbage and Removal of Offal.—Table K presents a statement, by months, showing the number of dead animals, the number of tons of garbage, and the number of barrels of night-soil collected and removed during the year. The number of dead animals is 8,344, an increase of 390 as compared with 1889; the number of tons of garbage is 23,914, an increase of 1,880 over the year previous; and the number of barrels of night-soil was 20,554, a decrease of 1,115 as compared with the year previous. The decrease in the number of barrels of night-soil may be accounted for by reason of the fact that the sewers have been extended in many places, and water-closets have taken the place of the numerous privy-boxes. The increase in dead animals is almost entirely attributable to the number of dogs killed at the pound.

The large increase in the amount of garbage collected during the year may be attributed to an increased efficiency in the service, additional funds having been provided and an inspection force inaugurated. The sum provided at the present time is not, however, sufficient to secure a service such as we are attempting to perform, that is to say, the removal of all accumulations from dwellings tri-weekly, and from hotels, markets, and provision stores daily, when necessary. The contractor has employed during the year from fifteen to twenty-six two-horse wagons, with two men to each wagon, these wagons carrying eight barrels each, and making as many loads as possible per day. In addition to this service, I issued during the year 127 permits to itinerant gatherers, under conditions that the garbage would be removed by each from certain dwellings, these dwellings being specified, and the gatherer held to account for the regularity of collection and the general character of the transportation. These private collectors are to-day taking the garbage from 945 dwellings in the city. I am thoroughly convinced that if the city itself should take control of the garbage service and attempt to do the work which we expect of the contractor it could not be done for less than $30,000. This is a service which demands great care, and which causes no end of complaint. The inspection service has proven to be a very valuable addition to the work, and I shall expect to see it much improved during the coming year. I hope that congress may be prevailed upon to appropriate at least $25,000 for this service.

FINAL DISPOSAL.

The majority of health officers consulted on this subject favor the process of cremation, while some prefer the extraction or reduction process by which the garbage is converted into commercial purposes. The Committee does not regard these as ideal methods for all forms of waste, and still they are not prepared to suggest at present any alternative which is so well settled even in theory, and still less in successful practice. Briefly stated, the attitude of the Committee is this: Different kinds of waste require different methods of treatment.

Of course, ashes cannot be disposed of by either of the above named processes. They cannot be burned, and, mixed with other garbage, they interfere very much with the burning. In the great majority of cases the practice is to use ashes for the filling of low lands, and this is entirely permissible, provided great care is taken to completely separate this from all kinds of organic wastes. The promiscuous dumping of vegetable and animal wastes upon low lands for filling purposes cannot be too strongly condemned. Covering them with a few inches or a few feet of earth does not necessarily destroy their power to harbor disease germs, which may be ready to spring out and produce an epidemic of disease at any time when favorable conditions shall have been established. Again, being already the products of oxidation, they cannot decompose and thus pro duce any of the evils incident to decaying and decomposing material- They are inorganic, mineral, and cannot harbor germs either of decay or disease. Clean ashes are not unsanitary products, and can therefore be safely used in filling low lands. For this they find constant use in every city. Street-sweepings, composed largely of dust and animal ordure, are useful as a fertilizer, and may be used as top dressing for lands that are being filled for building purposes.

For the vegetable wastes, garbage proper, the farmer will claim it as a privilege to take these home to be used as food for his cattle and hogs, while the keepers of hotels, boarding-houses, restaurants, etc., will claim it as their right to dispose of these wastes, if perchance they may realize a few cents or dollars for the same. The Committee regard it as a very doubtful sanitary proceeding to accommodate the milkman by allowing him to carry away decaying kitchen refuse to-day, and to-morrow return it to be used as food for children, in the meantime having passed through a poor, and it may be filthy, bovine laboratory called a cow. "This innocent economizing in parents may save a penny or two a quart on milk, but in return it will bring doctors' bills, disease, and it may be death." As to the manner of collecting and transporting this form of refuse, it must be insisted that if the farmer is allowed to carry it away, he must do it in the same kind of a wagon and under the same regulations as govern the hauling of all other forms of refuse.

The law of supply and demand seems to regulate fairly well the disposal of the ordure of animals.

According to the method proposed by Dr. Clark, garbage is stored in closely covered boxes, carried in these to the garbage-wagon which is also closely covered, and carried by the latter to the place of final disposal; and thus it never becomes visible to the eye from the time it is so stored by the householder, until finally disposed of. The method is an ideal one, and at the same time perfectly practicable, and putting it into practice in our large cities will eliminate many of the disagreeable features from the whole problem.

The Committee design, if continued in this work, to make a study of all the methods now used for final disposal, informing themselves of the comparative cost of plants, the expense of operating, the capacity of works, the adaptability of the different systems to larger and smaller cities, etc., etc.

Respectfully submitted:

DELOS FALL, *Albion, Mich.*,
DR. GRANVILLE P. CONN, *Concord, N. H.*,
MR. CROSBY GRAY, *Pittsburgh, Pa.*,
RUDOLPH HERING, C. E., *New York.*,
DR. EDWARD CLARK, *Buffalo, N. Y.*,
} COMMITTEE.

APPENDIX.

"B."

COLLECTION AND TRANSPORTATION OF GARBAGE AND NUISANCE-PRODUCING WASTE IN CITIES.

BY EDWARD CLARK, M. D.,
Buffalo, N. Y.

The first great task that every municipality must undertake, as the initial step toward successfully solving the "garbage and refuse problem," is a thorough education of the masses on the importance and necessity of forever keeping garbage and all nuisance-producing refuse separate from street dirt, ashes, tin cans, bottles, old shoes, etc. This educational crusade must be carried on, in part by appealing to the moral and intellectual sensibilities of the public, and partly by compulsion. The more enlightened and cultured portion of our population, and those who have a just appreciation of the importance and necessity of observing hygienic rules and regulations, need only to have pointed out to them the unwise and dangerous practices to which many of them at times unwillingly resort, to have the evils speedily remedied. On the other hand, in all of our large cities we find a population, whose name is legion, made up of a conglomerate mass from different nations of the earth, who have almost no regard for personal cleanliness, and much less for hygienic requirements, many of whom seem to be in their most natural and satisfactory environment when surrounded by a filthy and nuisance-laden atmosphere.

It is to this latter class of individuals that the compulsory educational methods in hygiene must be applied. The foundation upon which a superstructure of compulsion is to be erected must be furnished by the municipality in the shape of rigid and severe ordinances, rigidly and severely enforced.

The ordinances relating to this subject, and indeed all health ordinances, should be definite and specific, and so simple that the wayfaring man, though a fool, need not err therein. They should specify what kind of receptacles are to be used for garbage and other refuse; that garbage and other nuisance-producing refuse must never be placed in the receiver for ashes, street dirt or sweepings, tin cans, bottles, old shoes, and other dry material.

The inspection forces of a city should be clothed with full police power, so that it would be almost impossible for any person to escape detection for violation of a health ordinance, and justice should be so righteously administered, that, upon convincing and proper evidence of guilt, the offender could not escape the penalty of such violation. The kind of vehicles used for the transportation of garbage and other refuse should be specified, and the collection and removal of garbage and waste should be done at specified times, always subject to the rules and regulations of the health department, and under the immediate supervision of some of its attachés, each of whom should be held to strict account for the manner in which the work under his immediate supervision is performed. In fact, the whole matter of handling and disposing of garbage and all nuisance-producing refuse should at all times be under the control and management of the city's health department,—this, for the reason that garbage, and all vegetable and animal refuse, are among the great nuisance-producing factors of the age; and, as I understand it, dealing with nuisances and their causation is the especial prerogative of a health department. The question of street cleaning, and the removal of ashes and refuse of all kinds, not animal or vegetable, may at all times be safely relegated to the supervision of other departments, but the question of dealing with garbage and dead animals—never. This belongs to the health department, as much as does the management of an epidemic of small-pox.

Perhaps it is not advisable for a municipality to own the plant for doing this work, for this implies a large and perhaps unprofitable investment, and necessarily multiplies the number of places to be filled by political preferment. As the amount of work to be done can be pretty accurately determined, it would perhaps be best and most economical for the city to let the work by contract. What I insist on is this, that, no matter who does the work, it should always be done subject to the regulations and requirements of the health department, and under the supervision of men connected with, and responsible to, that department.

Having said so much by way of preface, it is now my intention to go into detail, and offer, first, a few suggestions relative the subject of "receptacles for storage prior to the time of collection." The results of my studies and observations have led me to believe that by far the best receiver for garbage and refuse, and even for ashes, is a galvanized iron tank holding about two or three bushels; it should be strong, and firmly made, and provided with a tightly fitting flange cover. It should be portable, and for this reason should be provided with handles on either side. It should never be uncovered, except when absolutely necessary, and should be kept in the rear of the house, or in the basement areas or passage-ways, and never upon the street or sidewalk.

The collectors should be obliged to go into the yard or area, carry the receptacle containing the garbage and refuse to their wagon or cart, remove the cover, dump its contents, replace the cover, and carry the receptacle back to its proper place. This is necessary, as it will prohibit the householder or store-keeper from setting out on the sidewalk, or at the curb-stone, his garbage- and refuse-barrels—a practice now altogether too common, and which ought to be prohibited by penalty under any and all circumstances.

I have in mind now a picture of a most beautiful avenue in one of our most beautiful cities, where on warm summer mornings a row of filthy, stinking, open garbage-barrels and boxes may be seen upon either side of the street waiting for the collector to come along and remove their contents.

They are placed at the curb-stone on the collection days, perhaps at five or six o'clock in the morning. The collector may get around before noon to gather their contents, and he may not. On an average, they stand for a period of five or six hours, fuming and stewing in the heat of the summer sun—an unsightly picture, a menace to the health of the passers-by, and a shameful disgrace to the city in which such a condition of things is allowed to occur. This picture is not overdrawn, and I doubt not its parallel can be found in most of our larger cities.

The same kind of receptacle as the one above described can be used for storing ashes, store-sweepings of all kinds, tin cans, bottles, old shoes, scraps of paper, etc., or perhaps a larger receiver can be used for some of this material. None of the materials above named should ever be thrown on the streets or sidewalks, but should be carefully carted away with the street dirt, and used for filling purposes. Decaying or rotten fruit and vegetables from stores and markets, and all confiscated meat and fish, should be subjected to the same rigid treatment as is the garbage from houses and hotels.

In many cities the large hotels derive quite a revenue from the sale of the garbage and table refuse to people who use it principally for feeding hogs. This is a practice to be condemned, but it is a delicate question with which to deal. I am of the firm belief that the health department of a city in which this is done should insist upon it, that, if sold at all, it should not be sold to, or fed to hogs or chickens by, any one residing inside the city limits, and that those who purchase the stuff should be compelled to remove it in the night, and in tight barrels or tanks similar to those used in many cities for transporting night-soil.

The storing and transporting of manure, or stable refuse, is a subject with which boards of health in our Eastern cities have little to do. This commodity is in great demand for fertilizing purposes by the numerous market-gardeners surrounding the cities, and, as the supply is hardly ever equal to the demand, it is eagerly purchased, and rapidly carted away into the country.

The owners of the carts or wagons used for this purpose, however, should be notified that these vehicles must be made water-tight, and have suitable covers, so that no part of their contents can escape on the streets; and any person using a cart or wagon, for removing manure, which does not comply with these requirements, should be subjected to a penalty.

There are many and diverse kinds of carts, wagons, and other vehicles used in different cities for the transportion of garbage and refuse from the place of collection to the place of disposal: a few of them possess some degree of fitness for the purpose, while many of them are imperfect, and inadequate for the work for which they are used. They are faultily constructed, not having any arrangement by means of which their contents can be quickly dumped. And many of them have wooden boxes, which are old and leaky, and, having no covers, their contents drip and drop along the streets, this creating and perpetuating a nuisance.

Whether carts, or wagons, are to be preferred for transporting garbage depends, I think, somewhat on the distance the material is to be hauled. I am of the belief that, viewing this matter from the economical stand-point, carts are preferable for short hauls, and wagons for long hauls.

Whichever vehicles are used, however, they should, without exception, have water-tight boxes, made preferably of boiler-iron, just heavy enough to give them the necessary strength. Both carts and wagons should be constructed so that their contents can be easily and perfectly dumped. They should all be provided with tight covers, either wood or iron, preferably iron with overlapping flanges. The use of canvas covers for a garbage-cart or wagon cannot be too strongly condemned. When the carts or wagons are dumped at the place of disposal, they should be thoroughly flushed out with a large nozzled hose, the water being carried at once into the sewer by proper arrangements for that purpose. The driver of the cart should attend to this duty, and if found going back after another load with a cart or wagon not properly cleaned, it should constitute cause for immediate dismissal. In a word, these carts should be kept so clean and free from odor that they would not afford any indications of the use to which they were subjected.

If the ideas above suggested, with reference to the construction and proper care of wagons and carts, be put in practice, it would seem that the unpleasantness arising from the carting of garbage and refuse might be reduced to a minimum. At any rate, "a long suffering public would be gratified, if not benefited, by seeing garbage-wagons and carts pass through the streets with their contents carefully covered, and return for fresh loads without offending one of the most valued senses."

The form of cart to which I give preference is a two-wheeled dump-cart, with a box made of boiler iron, hopper shape.

A short time ago, at Buffalo, N, Y., the mayor appointed a citizens' committee on street cleaning and garbage removal. He honored me by appointment on that committee, and I urged the use of such carts for short hauls. They are now in use by the street commissioner, and I understand they are perfectly satisfactory. The only objection to them is an absence of the iron cover. Another good cart is known as the "Flannagan automatic garbage-cart."

No matter what process is employed by a city for the destruction of garbage and refuse, the inhabitants in the vicinity of the works will bitterly complain of it as a nuisance, and rightly so, too, unless extra precautions are taken to keep the premises in a state of cleanliness, and to have ample provision for the immediate reception and disposition of all refuse that is brought to the place. Under no circumstances should garbage and other nuisance-producing refuse be dumped on the ground on under sheds about the premises. Immediately on being brought to the works, it should be dumped at once from the the cart or wagon into the dryers or furnaces, and not a pound of it be allowed to accumulate in and about the building. If this were done, I am quite satisfied that the multitudinous complaints about these places being colossal nuisances would grow rapidly and beautifully less. But so long as the arrangements for receiving and disposing of refuse remain as defective as they have been, and are, in most of the works, these complaints will multiply, and ere long the prejudice against them (the works) will become so deep-rooted that it will be well-nigh impossible to eradicate it. The works of the Merz

Co., at Buffalo, are located just outside the city limits, in what is known as the town of Cheektowaga. When they were first put in operation, a large amount of garbage was allowed to accumulate under the sheds in the rear of the works. This was brought about, partly by the deficient construction and limited capacity of the works (this being the first plant of the kind erected), and partly by the fact that tin cans and other substances had to be separated from the garbage before it could be introduced into the dryers. The people in the vicinity complained bitterly of the place, and the town board of health threatened to go into the courts with the matter unless the evil was speedily remedied. Owing to improved methods in collection, and promptness on the part of the company in perfecting and enlarging their plant, the evils complained of were removed, and I learn that the works have since been running day and night without any complaints being made against them. I cite this one case, with which I am perfectly familiar, in support of my statements. I doubt not that other cities have had a like experience. There seems to be an almost unanimous sentiment among health officials that during the night or early in the morning is by far the best time for the collection of refuse, garbage particularly. From inquiry, I also learn that nearly all are agreed that the garbage and refuse from hotels, restaurants, and boarding-houses should be removed daily, and that in the tenement-house districts, and in the thickly populated sections of a city, at least two or three collections a week should be made in the summer-time.

The above remarks embody the opinions I have formed as the result of my own studies and observations in this important department of sanitary science. When Professor Fall, the chairman of our committee, informed me what division of the work was assigned to me, I at once sent out a circular letter (of which the following is a copy) to the medical health officers of thirty-five of the largest cities in the United States and Canada, asking for information as to what was being done in this department in their respective municipalities.

BUFFALO, N. Y., Sept., 1891.

Dear Doctor:—I am preparing a report on the collection and transportation of garbage and refuse, for the next meeting of the American Public Health Association, and, if possible, I would be much pleased to have you furnish me, at your earliest opportunity, full and explicit answers to the following inquiries:

1. Have you a regular and systematic method of collecting and disposing of your garbage and refuse?
2. How many tons are collected daily, and at what expense?
3. Does the city do the work with its own plant, or is it done by contract?
4. What kind of carts or wagons do you use, and what do they cost, each?
5. Is it collected during the day, or at night?
6. How many collections are made each week in the thickly populated parts of the city?
7. What kind of receptacles are used by the people for storing the garbage until collected?

I would be pleased also to have your opinion on the following questions:

1. Do you think that cities should do this work under the supervision of the health department?
2. What are the best hours for collection?
3. What carts or wagons are best?
4. What are the best receptacles for use by the people until the time of collection?
5. Are wagons better for long hauls than carts?

Any information bearing upon these points, and also copies of any municipal law relat ing to the same, will be greatly appreciated by

Yours truly,

EDWARD CLARK, M. D.,

271 Franklin St., Buffalo, N. Y.

Most of the officials to whom the above circular letter was sent replied to the same,—some briefly, others at great length. I have annexed hereto such portions of their replies and opinions as have a direct bearing upon the subject with which this division of the report has to do, and which I think are a corroboration of many of the opinions to which I have given pretty positive utterance in the foregoing remarks.

Dr. Knight, clerk of the board of health of Hartford, Conn., says that in that city ashes and garbage are collected separately. The garbage is collected and removed by contract. Ashes are collected weekly, garbage three times per week. Covered tin cans are used for garbage receptacles when they are likely to cause offence.

Dr. Wingate, commissioner of health of Milwaukee, says that the garbage is kept entirely free from ashes and other refuse. All decaying fruit and vegetables, meat, fish, etc., go in with the garbage. Ordinary wooden carts or wagons are used for removing all of the refuse; they are provided with covers, and made water-tight. The teams, men, and wagons are hired by the city. Collections are made in the summer-time between 4 a. m. and 12 m; in the winter, between 6 a. m. and 2 p. m. Collections are made daily from hotels, restaurants, and boarding-houses in the summer-time, and from private houses at least twice a week. This custom does not vary much in the winter.

Owners and tenants are required by law to provide water-tight boxes as receptacles, which are mostly made of wood. He believes that this work should always be done under the supervision of the health department. Advocates early hours for collection, metallic tank or box receptacle, and recommends "Flannagan's steel cart."

Dr. J. S. Leal, health officer of Paterson, N. J., says that the work of collecting is let by contract; garbage and ashes are kept separate. Collections are made during the day, and open two-horse wagons are used. Three collections a week are made in thickly populated sections of the city. He recommends covered metal receptacles, and believes that this work should be done under the supervision of the health department. He prefers one-horse iron-covered dump-carts for transportation, and thinks during the night or early morning the best time for collection.

Dr. Wright, health officer of New Haven, Conn., says that garbage and refuse in that city is removed partly by contract, and partly by persons licensed for the purpose by the board of health. Wagons are used, holding about six barrels each. Collections are made about three times a week, from May to October, and twice a week from October to May. Barrels and boxes are used for garbage receptacles, but iron cans are recommended. He believes this work should always be done under the supervision of the health department, but thinks the contract system perhaps the most economical for the city.

Dr. Allen, medical health officer of Toronto, Ont., says that the plant for garbage collection belongs to the city. Some use barrels, others iron cans, and others let garbage lie in heaps on the ground. He believes early morning the best time for collection, and recommends covered iron cans as best receptacles.

Dr. H. B. Horlbeck, health officer of Charleston, S. C., says that the work of removing garbage in that city is entirely under the control of the health department, where he believes it always should remain. He believes early morning the best time for collection, and prefers carts to wagons for transportation. Two-wheel open dump-carts are used, and are owned by the city. Collection is made daily, and barrels and boxes are used as receptacles.

Dr. Laberge, of Montreal, says that in that city garbage and ashes are mixed together, and about one hundred tons daily are collected by contract. Boxes and barrels are used as receptacles, but they must be water-tight. Open heavy wagons are used for transportation.

In San Francisco, the garbage is collected by private individuals, costing each householder from fifty cents to two dollars and fifty cents a month. Covered wagons and carts are used, and collections are made in the day-time. In some parts of the city daily collections are made, in others it is collected weekly. Galvanized iron barrels are generally used as receptacles. The board of health designates what kind of wagons and carts shall be used.

Dr. Gapen, health officer of Omaha, says that the garbage in that city is collected by licensed haulers. Wagons and carts both are used for hauling, and the only requisite is that they be water-tight. Collections are mostly made in the day-time, except in the central parts of the city, where it is done at night. Two collections are made each week. No particular kind of receptacle is used.

Dr. Gapen believes a city should own its own plant for doing this work, and that it should be under the supervision of the health department. He recommends galvanized iron cans as receptacles, which should be furnished by the department at cost. He believes the cans should be placed in the wagons, and a clean, empty can substituted for the one taken. Wagons and carts should be tight, and he thinks wagons better for long hauls than carts.

In Toledo, Ohio, the removal of garbage and dead animals is let by contract, at a cost of $10,000 per year. Closed water-tight wagons are used, which cost $120 each. Collections are made in the day-time, and on alternate days. No particular kind of receptacle is used. The health officer believes this work should be done under the supervision of the health department, and recommends closed iron cans as receptacles, and wagons for long hauls and carts for short ones.

Dr. H. F. Hoyt, health commissioner of St. Paul, Minn., says that in that city about thirty tons of garbage is collected daily, at a cost of $11,000 per year. The work is done by contract, and collections are made daily and tri-weekly. One-horse covered wagons are used; iron cans, barrels, and boxes are used as receptacles. He believes that this work should always be done by a responsible contractor, under the supervision of the health department. That the garbage from hotels, and in the business portion of the city, should be collected at night, and in the resident portion of the city before 9 a. m. Prefers carts to wagons for hauling, and recommends galvanized iron cans as best receptacles.

"C."

WHAT IS THE BEST WAY TO COLLECT AND REMOVE THE WASTE OF TOWNS AND CITIES, AND WHAT DOES IT COST?

By Col. W. F. MORSE,

New York.

This inquiry is frequently addressed to those whose business relations bring them into association with the civic authorities of cities and towns having in charge the business of collecting and disposing of garbage. They are questions which are being presented by a great number of places which heretofore have ignored the subject, and now find themselves compelled to give it attention. They are questions more easily asked than answered, and however much care and time may be employed in endeavoring to solve this municipal problem, there will still remain a vague and unsettled feeling that no definite and positive conclusion can be arrived at. The scavenger service of a city or town is one which involves a considerable, and in some cases a very large, expenditure of money, the control of a large force of men, the care of an expensive equipment, of teams, horses, stables, etc., and the great responsibility of the public comfort, its cleanliness and health.

Every other department of sanitation has been animated by a spirit of inquiry and investigation, which has led to the expenditure of great sums of money in trials of inventions, the publication of numberless volumes of theory, of many experiments in the ventilation of dwellings and buildings, of strenuous efforts to obtain the purest and most bountiful water-supply, of ordinances and laws to prevent the adulteration of food-products and supplies, and the building of elaborate systems of sewers. All these questions have received attention, but the subject of the cleanliness of the community, as affected by the presence of all classes of waste and refuse, and as governed by the more or less perfect or imperfect system of collection, removal, and disposal of all this waste, is a matter which has been left to care for itself in the great majority of places. Not until the civic officials are driven by the complaints and remonstrances of the public, and by the presence of an absolute and pronounced nuisance in their midst, do they take any effective step towards giving relief.

The method at present in use in most of the cities of the country appears to be an outgrowth of the crude and imperfect way which was originally employed when these places were small towns and villages. In the beginning, every person was allowed to dispose of his own refuse in his own way, and by common consent all waste matters were deposited in the back yards, by the kitchen doors, or in some outlying place—out of sight if possible, out of mind in any event—and no care was taken to destroy or cover it. In a short time there appeared, on the surrounding line of these towns, piles of waste matter, unsightly, unsanitary, and obnoxious. These accumulations presently became mounds of rotting refuse, giving off stenches and offensive gases, the breeding-places of the lower forms of animal life, which, even when covered over with earth, if used for the location of dwellings, formed a starting-point from which radiated infectious diseases.

Being without any sewage facilities, these villages and towns used the privy-vault as the only place for the reception of human organic waste, and annually or oftener the contents of these vaults had to be excavated and taken away. This work, disagreeable and filthy in itself, fell into the hands of parties having only the lowest order of intelligence, was performed usually without any oversight or attempt at disinfection or sanitary precaution, and they were at liberty to dispose of this offensive and dangerous matter in any way that best suited themselves, provided public attention would not be too much attracted by their methods. As the place increased in population, so these methods of garbage and night-soil collection and disposal were simply extended to meet the requirements. There would be, possibly, an attempt at some oversight or supervision of the process, a policeman would have power to arrest offenders who made too public an exhibition of their refuse dumps, and occasionally the night-soil contractor would be fined for poisoning the earth and air which belonged in common to the community. This, in effect, is the way in which nine tenths of the cities and towns of the United States deal with this question of garbage and night-soil collection and disposal. Evidently there is need of reform, of the institution of better methods, and of the substitution of strict rules, in place of unlimited license in this direction.

The *amount* of garbage and waste to be collected is an interesting question. According to the report of the commissioner of street cleaning for the city of New York, the amount, per capita, of garbage, refuse, street-sweepings, and ashes yearly collected in that city, is about one cubic yard to every inhabitant. This takes no account of night-soil, which is carried off in the sewers. This estimate has been found by experience to be very nearly the quantity which is annually produced in the average American city. For purposes of a rough calculation it is easy to estimate one cubic yard per annum of refuse, garbage, and waste material generally for every person, and, while the kind or character of garbage may vary with the different localities, as a rule the amount which is annually produced will vary but little from this quantity.

The proportionate amount of the different classes of garbage is a question which can only approximately be arrived at. In New York it is estimated by the health authorities that in the winter season about seventeen per cent. of the total of garbage collection of the city, and in the summer season about twenty per cent., represents the animal and vegetable matter liable to putrefaction, which is garbage proper. In New England, where the house offal, as a rule, is collected separately from all other kinds of waste, the average of six cities shows that the percentage of putrescible matter, as compared with the whole amount of garbage and refuse collection of the city, is about twenty-two per cent. In the Southern cities, where the colored population consume an enormous amount of vegetable food, making a proportionate quantity of vegetable waste, the summer collection of putrescible matter will amount to twenty-five per cent. of the whole amount of collection. In six Western cities the percentage of putrescible matter in the garbage collection is estimated to be about twenty per cent.

From the mean of these figures, which have been gathered with some considerable trouble and difficulty, it may be stated that about fifteen to twenty per cent. represents the amount of animal and vegetable matter which is putrescible in character in the ordinary winter garbage collection of a city, and about twenty-five per cent. in the summer and early autumn months.

WHAT IS THE BEST WAY TO COLLECT THE GARBAGE? IS IT BY THE CONTRACT SYSTEM?

By this method a city or town makes a contract with a specified party to collect in his own carts the garbage, ashes, and refuse, and convey the same outside the city limits. Often a contract is made with the same party to sweep the streets and to convey away dead animals. Contractors are required to make collections two, three, or six times a week; to make these collections in a tight cart which will not allow any wastings or droppings on the streets, to keep this cart clean, not to allow it to loiter on the streets, and generally, according to contract, to perform the work in a way that is satisfactory to the department and to the sanitary inspectors. In almost every case the Health Inspectors' Department is at war with the contract service from the beginning of the work. Competition often brings the price down to such a figure that a very narrow margin of profit is left for the contractor, and this means not a sufficient number of teams and men to do the work, an evasion or non-compliance with the requirements of the city, or—a financial loss. Inasmuch as his object is to get over the ground quickly, to collect the smallest amount of garbage at the greatest price that he can get and keep just within the rules of the inspection service, unless he is vigilantly watched the contractor is very apt to instruct his men to hurry with their loads, to cover the allotted route quickly, and to get through in the shortest way possible. There is no special need, in his estimation, of keeping his carts clean; therefore there is always an effluvium surrounding these vehicles which heralds their approach. There is rarely, if ever, any attempt on his part to enforce the regulations of the city requiring deposit in separate vessels of garbage, ashes, and waste, and here is the critical place at which all well digested systems of improvement, the elaborate ordinances passed by cities, and the care and painstaking of its sanitary department, break down, and are of no effect or use, unless the contractor will coöperate with the authorities, instruct his men, and see that they carry out his orders of refusing to take putrescible matter when mixed with ashes. The pressure upon the contractor's employés to take whatever waste is set out from the household, the temptations offered by a "tip" or by persuasion of the householder to "take it away just this once," are so great that the usual result is a load of mixed garbage and refuse, ashes, and everything else, which no earthly power can thereafter separate into its constituent parts, nor wisely provide for the disposal of.

It has repeatedly occurred, that cities which have established a plant for the cremation of garbage have had difficulty and annoyance in satisfactorily operating this plant because of the wilful negligence of the contractors, or persons employed in collection of garbage, in refusing to assist in the enforcement of the ordinance requiring a proper separation by the householder.

It is the object of the contractor to do the least work and get the most money out of it; and from the nature of his occupation, and from the fact that he is dealing with worthless material, every man's hand is against him, and he has no inducement, except the bare fact of a money recompense, to give thoroughly good service. As a rule, he selects for his place of final disposal a dump as near as possible to his field of collection, and here he continues to throw every kind of abomination until driven out by indignant neighbors, when he migrates to some other point.

Under his system of dumping, at points near the city lines, the matter which he removes from the city is daily hauled over by people (men, women, and children) possessed with the idea that a garbage-dump is a gold-mine, requiring only to be thoroughly dug over to make the digger wealthy. As a natural result, quantities of worthless stuff are picked up, carried back into the town, to be again discarded and taken away by the contractor, and again carried out. Whenever it happens that a bit of cloth, an old garment, or any material which has been in contact with persons ill from contagious or infectious diseases, finds its way into this garbage-dump, it almost certainly happens that this is found by some woman or child, and, under the guise of "rags," is taken back into the city, to become a new plague-spot and breed a new attack of infectious disease.

This practice of allowing persons to pull over and recover from dumps articles which have been thrown away is one which should be strictly prohibited, and the prohibition enforced by every community which has any idea of caring for the protection of the health of its people. The spread of diphtheria has been traced directly to this practice, and no amount of warning ever seems to be of use.

NIGHT-SOIL COLLECTION.

Whenever a city or town has only limited sewerage facilities, the night-soil contractor becomes a man of some importance. The knowledge that organic waste of the human body has always been and always will be a poison to be guarded against, is a sanitary maxim which is slowly but surely making its way in the minds of the great public. Hence, it comes about that the removal of the contents of vaults and privies is done oftener now than in former years, and that the arrangements for the removal and disposal of waste of this kind have assumed of late years an importance which was far from belonging to them heretofore. Under the contract system employed in most places, a party is licensed to remove night-soil: he is authorized to ask only a certain amount or sum of money proportionate to the amount excavated; he is obliged to use a specified form of sealed barrel, and is supposed to keep these in a cleanly sanitary condition. He is required to do the work only at night-time, when it is supposed that the least offence would be given to the smallest number of people,—and there the requirements stop. The ultimate disposition of this mass of dangerous material is left to his own fancy. Being under no special oversight or regulation as to disposal, he takes it to some point where it is moderately certain he will not be detected—nominally outside of the city limits, but oftener within its border—and digs a narrow pit in the ground and deposits it therein; or, he may contract with a farmer to scatter it upon the surface of the ground, to be supposedly ploughed under; or, he may, as is done in some Northern cities, collect, at some short distance away from the boundary of a city, an enormous reservoir of this offensive material, and, by treatment with muck, earth, or tan-bark, allow it gradually to become deodorized and inoffensive.

Several years ago there were a number of establishments in this country for the manufacture of poudrette, a form of commercial fertilizer the basis of which was night-soil. The business was prosecuted with vigor, as it was supposed the returns would be very large, the principal ingredient costing nothing except the trouble to haul it to the factory. But it was presently discovered that the exceedingly offensive material with which they had to deal, united to the great cost of manipulating it into a form which could be handled without nuisance, exceeded the value of the fertilizer when manufactured; and the business was run at a loss, and given up. In other words, the present state of the fertilizer business in this country, and the great variety of articles which are useful at moderate prices for the enrichment of the soil, do not allow the profitable manufacture of compost from organic waste.

In a similar way there have been, and are now, many attempts to produce a valuable product from garbage. It is customary at many places to haul out upon the adjoining farm-lands the putrescible animal and vegetable matter, ashes, etc., of the garbage collection, and to plough into the soil all these constituent parts that can be subjected to such process. This may operate as a means of getting rid of garbage, but as a process for the betterment of the soil for producing food-products it is a great mistake.

The best evidence on file from the agricultural experiment stations of the country, and from the reports of scientists abroad, is, that garbage in its raw state is not a fertilizer, and does not enrich the land. Moreover, there is a very strong and warranted prejudice against using the products of a garden which have been grown by the direct application in its raw state of night-soil and garbage as a fertilizer; and the statement has been made by those whose sphere of observation has been exceptionally good, that certain classes of vegetables betray by their taste and odor the presence of the nitrites upon the ground in which they were raised.

The collection, removal, and disposal of garbage for municipal corporations by contractors may be fairly successful under certain conditions, where heavy bonds can be exacted and strict oversight and inspection maintained; but as a general rule, the experience of the American cities has been to the effect that the contract system is unsatisfactory and objectionable.

THE MUNICIPAL SERVICE.

The other method of collecting and removing garbage is where the municipal authorities undertake the whole service. It requires the investment of a considerable sum in teams, apparatus, stables, etc., and the employment of a large number of men. But these teams and men can be, and often are, used for other branches of the municipal work, thus dividing the expense. The inspection service can be more exactly performed, and the responsibility for the cleanly and efficient collection from the household can be more exactly placed. The householder, if his garbage is not taken away, has a means of redress by applying directly to the city authorities, and they in turn know precisely whom to blame for the neglect, and are thereby enabled to apply immediate remedy. There is no referring a matter to a contractor, who refers it to a foreman, who interrogates the man who drove the cart,—thus filtering through three different channels and arriving nowhere at the end. The responsibility of employés, when they are the servants of a city, is greater than when they are working for a private contractor. Their terms of office are more stable, being dependent on their personal behavior. They are more apt to take pride in the efficiency and appearance of their teams, and it is certain that, under proper inspection, they do vastly superior and more thorough work. The responsibility for the cleanliness of the city comes directly upon the officials having control. The householder feels as though his interests are being better looked after, and that his complaints are more quickly attended to and more promptly redressed.

A comparison of the reports of health officers of the different places in the United States affords positive evidence that the contract system is inferior to the method of direct control of the collection and disposal of garbage by the city or municipal government. Several of the larger cities, which heretofore used the contract system, are now about to resume direct control of their garbage collection; others, where the contract system is still in force, have before them the strong recommendations of their health officers that the contract method be set aside in favor of municipal collection.

The whole weight of evidence from experience and observation is directly in favor of the collection of the waste of a city or town by its own teams, under its own inspection, rather than by sub-letting to a contractor. There is, moreover, a better oversight of the final disposition of garbage when the city authorities are directly responsible for its disposal, since continual inspection is maintained down to the place where carts are dumped, and where the pile of refuse matter is finally deposited. It will not do to take away the household waste in a thorough way, in clean, covered carts, to transport it through the streets so that no chance of offence can occur, and then allow it to be dumped at some point where it will give offence to people surrounding, or may become a source of danger as the future foundation of streets or dwellings.

A perfect collection system will include,—

1. The division of the city into wards or districts of convenient size for collection and thorough inspection.

2. The appointment to each district of a sufficient number of sanitary inspectors, and of carts and men for the collection of garbage and refuse. In the summer-time, in this climate, a daily collection of household offal and garbage is almost a necessity. Under the hot sun, decay begins from the instant that any surface of raw vegetable or animal matter is exposed to the air, and goes on to a point where putrefaction renders the article offensive and obnoxious. But the point of decay which makes garbage offensive is not reached for some hours. Fresh garbage, meaning thereby animal and vegetable matter which will decay, is almost odorless, and, when in this fresh state, can be collected and hauled and deposited without any nuisance, provided the householder's garbage receptacle is kept clean, the cart in which the garbage is conveyed is thoroughly washed and disinfected, and proper care is taken to cover or enclose the carts in such a way as to prevent the escape of any of the material. Therefore a daily collection is always advisable during the heat of summer, unless the amounts are very small.

3. The issuing of a printed notice or circular, to be given to and posted up by each householder, containing information of the time when the garbage collection will be made at this particular place, and specifying definitely the description of vessels in which garbage, refuse, sweepings, and all waste matter will be received. This ordinance should provide a penalty against the depositing of ashes or non-combustible material in garbage receptacles. The householder will be instructed to provide a second vessel, which would contain the ashes and non-putrescible articles, the collection of which should be made by separate teams.

4. The city should provide for the collection of the ashes and refuse material once a week in summer, and two or three times in winter, as may be required.

The quantity of ashes in the garbage collection of a city or town, as a rule, is more than one half of the whole amount of waste in winter, and less than one fourth in the summer season. The object of the municipal regulations is to get these ashes for the city's use in filling lands and grading streets, and this can only be done by a strict enforcement of the regulations as to separation, and a continual inspection of the collection carts.

5. The collection cart should be, as a rule, of a capacity to hold one or one and one half cubic yards. Experience has shown that the cubic yard is the most convenient and available standard of measurement for city refuse. It is exceedingly difficult to tell the weight of a given quantity of waste, which may include a vast number of different articles or substances, each unlike the other. There is a standard of measurement by weight for household offal, which can be very nearly arrived at where this is kept separate from every other class of waste. One and one fourth cubic yards of garbage composed of household offal or "swill" will weigh 1,600 pounds, or a cubic yard will average about 1,200 pounds where it is mixed with the average quantity of liquid. On the other hand, three yards of garbage mixed with dry refuse might not weigh more than 1,200 to 1,500 pounds; so that, in computing the waste materials of a city as a whole, the cubic yard is the most convenient and most accurate standard of measurement. This collection cart, drawn by one horse, should be provided with a cover which closely confines the material and does not allow it to become scattered on the street.

6. An accurate account of the number of loads should be exacted from each driver, and thereby each man would be compelled to do his full quota of work. With a little experience it is easy to arrive at the quantity of garbage which a given number of people will produce for each season of the year, and economy of transportation and labor is maintained by keeping an accurate account of the amount collected. At the end of each month these separate numbers are collected and tabulated, and the report made to the proper officer. This system of garbage collection, under the inspection of the health officer of the city, who has, through his inspectors, absolute power of compelling the most thorough work, is the only one which will insure a cleanly, economical, and satisfactory gathering of the worthless waste and refuse of any community.

The collection of night-soil is a matter which is still more important, if possible, than the garbage collection, and one which, as a rule, receives less attention from the city authorities. Where a town or city is extending its sewer area, the matter of the vault or night-soil collection becomes of decreasing importance. Usually the regulations require that all new houses built upon the line of sewer shall be compelled to connect with the sewer, and it should be made imperative for every householder to do away with the privy-vaults and connect with the sewer whenever practicable. Modern sanitation has shown clearly that the larger number of the zymotic diseases are due to the contamination arising from the presence of the organic waste of the human body. Epidemics of diphtheria and typhoid are, as a rule, directly traceable to the poisoning of the water-supply and the atmosphere by the emanations arising from the defective sanitary arrangements connected with privy-vaults. The reports of health officers of cities and state boards of health are filled with protestations and warnings, pointing out the fact that the people are being poisoned by allowing vaults and cesspools upon the land which is occupied by dwellings, or where wells are sunk in proximity to them.

The final disposition of the contents of privy-vaults is a matter which requires the wisest care. Too often it happens that the vacant ground in the immediate vicinity of growing towns and cities is honeycombed with great pits containing vast amounts of organic waste, which become, when the ground is needed for purposes of dwellings, a positive danger as a source of infection. The soil takes up only such liquid particles as can slowly filtrate through it, the great bulk remaining very nearly in the same state as when deposited. At one of the government posts, where it was necessary to excavate the ground for foundations for new barracks, it was found that vaults that had been filled twenty years ago were in very nearly the same condition as on the day that they were covered over, no oxidation having taken place. In digging the earth for the foundation of a large block of buildings erected in one of the older New England cities, it was necessary to excavate the ground which had been covered by a house used as a dwelling for over one hundred years. An old privy-vault, dug at the time of the erection of the first house, and which had been covered over and not in use for a great number of years, was uncovered, and the contents were found to be in almost the same condition that they were on the day the vault was covered over.

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The report of the census of 1890, as contained in bulletin No. 82, upon the receipts and expenditures of the 100 principal cities of the United States, contains some very striking facts in this connection. It appears that while the "total ordinary expenditures" in these 100 cities is $235,064,127, the amount reported as expended for the purposes of "health" amounts to the sum of $2,280,317, less than one per cent. of the sum of the "ordinary expenditures" of each year. Taking examples out of a list: A wealthy New England city, whose annual expenditures are nearly a million, expended for the "health department" less than three tenths of one per cent. of the total sum; a Western city, expending nearly four hundred thousand dollars, paid about one twentieth of one per cent. for "health." Thus, the support of the department which has the care of the public health, the prevention of epidemic diseases, and the removal of nuisances, receives, by far, less money than any other department of municipal affairs.

An attempt has been made to bring together statistics of the cost of garbage collection, which might convey some adequate idea of the expenses attendant upon a thorough system under municipal control, but the information obtained is of so varied a character that accurate figures are impossible. Taking the largest city in the country, New York, as an example, the last report made by the Street-Cleaning and Garbage-Collection Department shows that in a population of one and one half million of people, one and one half million loads of garbage and refuse were collected, each load being about one cubic yard, and that the cost of collection and disposal of this amount was 81 cents for each cubic yard. This included the sweepings of the streets, the collection of ashes, and the collection of garbage and refuse, but had no reference to any sewage matter. The report also shows that about 18 cents represented the cost of disposal, taking a part on barges and dumping-scows about 22 miles by water and dumping it into the ocean, and disposing of the remainder behind bulkheads to fill low ground in the vicinity of the city.

It was expected when this paper was begun, that statistics of the cost of collection for the cities of this country, based upon the number of cubic yards collected yearly, could be obtained, but it has been found impossible to proceed in this way, as the records of amounts collected, except vague statements of "cart-loads," are not to be had.

But following the rule for computation suggested by the health officers of Providence, R. I., who state that 15½ cents per capita represents the annual cost of garbage collection in that city, then a table of approximate costs for several cities can be constructed.

Boston pays 22 cents per capita, and sells enough garbage to reduce this to 17 cents;

Chicago,	24 cents.	New Haven,	8½ cents.
Memphis,	31 "	Haverhill, Mass.,	5½ "
Keokuk, Ia.,	25 "	Newport, R. I.,	20 "
Los Angeles, Cal.,	27 "	Charleston, S. C.,	18 "
San Antonio, Tex.,	30 "	Lynn, Mass.,	12 "
Montreal,	11 "	Milwaukee, Wis.,	17 "
Detroit, Mich.,	17 "	Toledo, O.,	13 "

Washington has paid 6 cents up to the present time, but as this amount was too small to reimburse the contractor, he has stopped, and the city is collecting its own garbage, at an estimated cost of $40,000 per year, or 17 cents per capita.

St. Louis is reported to collect its garbage at a cost of $20,000 per annum, or about six cents per capita, the smallest amount of any of the large cities; but this applies only up to the beginning of this year, or a little later, when another contract for the collection and disposal goes into effect.

Philadelphia furnishes no statistics by which the collection of garbage is kept in a separate account from the street-sweeping and ashes collection.

This is also the case with Baltimore, Cincinnati, Indianapolis, Omaha, and Kansas City. These few examples are quoted as giving the extremes of cost in some of the cities and towns. They may not be exactly accurate, but afford an approximate idea of the expense incurred. The value of such a table is obvious, and when extended, as it will be, to include 50 cities and towns, it will form a basis for comparison of great service to places desirous of establishing some system.

But there is another class of cities which should not be allowed to pass unnoticed. In many places, especially in the West, there is literally no method of collection in use which is under the control of the city. From the first, each citizen was allowed to use his own discretion in getting rid of refuse, and no attempt has been made to exercise any oversight, except to designate a dumping-place where waste might be thrown. Cities of 100,000 people have no organized collection system, with no machinery for waste disposal, are without a system of license even, and are constantly in trouble with complaints of garbage nuisances. The knowledge that some better state of things might be advisable is slowly breaking its way into the official minds, and they will presently be seeking information of the best methods. Is not this question one within the bounds and province of this Public Health Association? and would it not be an act of charity and mercy to set on foot such an inquiry as shall convey in a concise way a hint of the best methods, and the cost of the same, to these inquiring, benighted, yet willing and anxious souls?

"D."

REPORTS OF HEALTH OFFICERS.

Albany, N. Y., Lem. Balch, health officer. 1. (a) Public dumps, contractors; (b) ditto; (c) by contractors to special dumps; (d) ditto; (e) Hudson river. 2. (a) None; (b) private contractors; (c) cleaning streets, $8,000 to $9,000 per year. 3. Private. 4. Any kind, barrels, etc. 8. No. 10. Generally to farmers, to pigs, etc. 11. General nuisance, from improper collection and methods of removal. 13. By putting it entirely under official inspection, and doing away with private contractors. It has repeatedly been urged that proper methods for ultimate disposal of garbage be provided for, proper carts be required, and the householder be required to have the garbage ready for collection at certain times, in proper receptacles, and that the whole of this work be under the charge and control of the board of health. As at present done, it is not only inefficient, but more or less of a nuisance. It is also urged that all sewage be intercepted by trunk sewers, carried below the city, and disposal arranged for by which the solid matter be removed and a purifier effluent alone allowed entrance into the river.

Binghamton, N. Y., Dan. G. Barr, health officer. 1. (a) Collected by superintendent of the streets; (b) carted at intervals by property owners; (c) ditto; (d) swill removed by farmers near city; (e) into Susquehanna and Chenango rivers. 2. No. (a) None; (b) none; (c) do not know. 3. Private expense. 4. Tight box-wagons. 8. Only on order of board of health. 10. In low, isolated places. 11. No. 13. By establishing crematory works, and by systematic collection of house refuse and garbage.

Brunswick, Ga., Alfred V. Wood, secretary of board of health. 1. (a) Carted to crematory; (b) mainly used on premises; (c) carted to crematory; (d) ditto; (e) a few private sewers empty into river; bulk carted to crematory. 2. (a) $3,500; (b) owned by contractors; (c) $2.50 per day for fuel. 3. By contractor. 4. Dump carts with metallic lining. 6. 10 to 15 loads. 7. 25% more than is now accomplished. 9. None. 10. Cremation. 11. No nuisance so far as to crematory, but much dissatisfaction at times with methods of scavengers. 12. By contractor. 13. By the work being done by city under a competent superintendent. (City pays contractor $300 per month, he furnishing everything, and having an average haul of one mile.)

Burlington, Ia., C. E. Barnes, commissioner of health. 1. (a) Dump; (b) dump; (c) river; (d) ditto; (e) ditto. 2. (a) None; (b) none. 3. Private. 4. Air- and water-tight barrels. 6. 15 tons daily. 7. 3 pounds. 8. Yes. 9. Farmers sometimes collect kitchen refuse. 10. Principally the river. 11. No. 12. Sanitary inspectors and dump-boat crew. 13. Cremation. In towns on so large a stream as the Mississippi river, cremation of garbage is a thing of the future. Our "dump-boat" carries all offal that does not tend to obstruct navigation, to a point in the stream below the city. Ashes, manure, street cleanings, etc., are deposited on a spot for that purpose, at the edge of the city. Dump-boat is used from 3 to 9 p. m. Owned by private parties.

Cambridge, Mass., Edwin Farnham, medical inspector of board of health. 1. (a)

Sold for filling; (b) ditto; (c) ditto; (d) there are practically no hotels; (e) sewers which empty into river. 2. (a) None; (c) street-sweepings, other than offal, are collected by the street department, at a cost of about $15,000 per annum. The house offal is collected by the overseers of the poor, and sold, or given to pigs kept at almshouse. The street-sweepings are collected in carts that can be covered with canvas covers; the offal wagons have wooden covers, hinged so that a part can be raised. The ashes are put in barrels, and placed on sidewalks by the householders once a week, and taken away the day they are put out, different sections of the city having their allotted day. House offal is also placed in separate receptacles, and carried off twice a week, except in summer, when the rule is to cart three times weekly. Street department has 9 horses and carts. Overseers of the poor have 12 horses and carts. Cost of collecting offal in 1890 was $18,000.

Charleston, S. C., H. B. Horlbeck, health officer, 1. Hauled out of city. (a) Used for filling; (b) ditto; (c) if objectionable, hauled out of city, if not, filling; (d) hauled out of city, hog feeding, etc.; (e) hauled out of city. 2. Yes. (a) None; (b) carts; (c) $19,000 to $20,000. 3. Public. 4. Carts, 2-wheels, dumping. 6. Average, about 100 loads daily. 8. Yes. 10. On waste salt-marsh lands. 11. None except odors, and it is deposited generally away from inhabited sections. 12. Hired by the city.

Chicago, John D. Ware, commissioner of health. 1. By contract. (a) By street department; (b) scavenger contract; (c) disposed of by owners; (d) ditto; (e) carried out of city. 2. No. (a) No. 3. Cleaning by wards by contract. 4. Tight-body wagons, canvas covers. 6. About 300 tons. 8. Yes. 9. None, except ashes for filling. 10. Garbage, outside limits. 11. No. 13. By the city owning and operating its own teams.

Columbus, O., W. A. McDonald, secretary. 1. (a) Dumped on vacant lots; (b) hauled out of city; (c) ditto; (d) ditto; (e) dumped out of city. 3. Private. 4. Air-tight wagons. 5. Private. 8. Yes. 10. Out of city. 11. Yes; not hauling before too much accumulates. 12. All private. 13. By the city government controlling it.

Council Bluffs, H. B. Jenning, health officer. 1. (a) Dumped outside city limits; (b) ditto; (c) ditto; (d) collected by men to fatten hogs; (e) into Missouri river, below city. 2. No. (a) No. 3. Both. 4. Tightly covered box. 5. Can't say. 6. Ditto. 8. Yes. (a) Not at all. 10. Outside city limits. 11. No. 12. Give license. We require scavengers to give license and bond. They keep alleys clean, and collect of property owner or occupant who caused refuse to be thrown in alley or street. All such material is dumped outside city limits.

Denver, Col., H. K. Steele, health commissioner. 1. (a) Dumped on River Platte; (b) ditto; (c) ditto; (e) into Platte. 2. No. (a) No; (b) no; (c) hired at $4 per day, cart and driver. 3. Public. 4. Iron or steel tanks, size 10 by 2 by 3 feet. 5. Do not know. 6, 7. Of garbage and filth in streets there are, on a rough average, about 85 tons gathered, being 28 wagon loads garbage and 32 alley cleanings. This does not include privy-vaults, cesspools, and dead animals. We average 30 permits for cleaning privy-vaults, cesspools, or grease traps daily. This would add 30 tons more to the 85,—total, 115 tons, or about 2 pounds to each inhabitant; the average would not much exceed this if thoroughly done. 8. No; hotel keepers and manufacturers generally remove their waste and garbage. 9. All thrown into the river; the tin cans can be sold to the smelter for $5 per ton. 10. River. 11. The river, at times low, does not carry off the material, and the odor is the principal nuisance: it must be changed. 12. Night-soil is removed by private parties; garbage carts employed by the board of health. 13. That is what we are earnestly seeking to ascertain, and are giving it much attention, but have not decided what is best. Have several methods in view; city tried the Merz system, but injunction was served to prevent its use.

Detroit, Mich., Samuel P. Duffield, health officer.. 1. Merz system. (a) Taken care of by the board of public works; (b) board of public works fill up low places; (c) taken away at their expense; (e) night-soil from privies taken outside of the city. 2. Does not own contracts. (b) Furnished by contractor; (c) about $36,000. 3. By contractor. 4. Closed water-tight wagons. 5. Not known. 6. From 55 to 60 tons in summer; less in winter. 7. At least one fourth more. 8. Garbage, yes. 9. Grease extracted and sold; residue sold to fertilizing company. 10. Everything worked up. 11. Yes; odors from works; having a suit now in courts. 12. Hired by contractor. 13. This will be a subject of paper from my pen next year. City is now on the point of again letting contracts. I cannot inform you at present whether the old system will continue. or whether a new contractor will have it this year. The garbage question is the greatest annoyance to a health officer.

District of Columbia, health officer. 1. (a) By contract, cars; (b) removed by private persons; (e) Potomac river. 2. (a) None; (b) hired. 3. Public. 4. 2-horse wagons, 8 and 10 barrels to wagon, 8. No. 9. None sold. 10. Outside district limits. 11. Yes; odors caused by delays or dereliction of collectors. 12. By the day. 13. We are in search of that information.

Dubuque, Ia., I. S. Bigelow, health officer. 1. (a) Used for filling lowlands near river; (b) ditto; (c) ditto, except organic matter liable to decomposition; (d) hauled off by farmers, or dumped into river below city. 2. (a) No; (b) no; (c) no. 3. Public. 4. Tight box. 5. Do n't know. 6. About 5 wagon loads. 7. Double the present, that is, 10 wagon loads for 31,000 people. 8. Yes. 9. None sold. 10. In river below city. 11. Yes; carelessness on part of citizens, and also garbage collector in collecting garbage. 12. Hired by the city. 13. By compelling sewer connection and increasing penalties for removing garbage. The city hires a garbage collector at so much a month for 6 months of the year. No garbage removed by the city during other 6 months of year. The city twice a year cleans all alleys of garbage and refuse material, and collects from each resident a voluntary contribution not exceeding one dollar. Some people are careless about throwing ashes etc. in alleys, and the ordinance preventing same is not rigidly enforced. It is found difficult to enforce it unless person is caught in the act.

Elizabeth, N. J., E. G. Putnam, health inspector. 1. Carted away; (a) ditto; (b) ditto; (c) ditto; (d) ditto; (e) taken in closed barrels to almshouse farm, outside of city limits. 2. Do not own them. (a) No; (b) no. 3. Public. 4. Wagons with high side-boards. 5. Costs city $4,600 annually. 6. Probably 10 tons. 7. 25 tons for the whole city of 40,000 inhabitants. 8. Yes. 9. None. 10. Lowlands outside city limits. 11. None. 12. Hired by scavengers appointed by the council. 13. By cremation. Trying to persuade city council to adopt ordinance compelling citizens to separate ashes from garbage. Will not be done at present. Hope to have a crematory soon for garbage, etc.

Elmira, N. Y., E. A. Reilly, health officer. 1. (a) Gathered by city teams and dumped into lowlands; (b) ditto; (c) the proprietors are obliged to cart them outside of city limits; (d) gathered by owners of hogs outside of city; (e) into Chemung. 2. (a) Have none. 3. Private. Fire-department teams and wagons remove street-sweepings and ashes. 4. Common dirt wagons. 5. Don't know. 6. Unknown. 7. Never had an occasion to judge, the work being done by the inhabitants instead of officially. 8. Yes. 9. None sold. No value from our poorly arranged system. 10. Beyond city limits in lowlands. 11. None that is brought to my attention except its apparent general crudeness. 12. By private individuals. 13. By establishing a regular system of garbage under the direction of the board of health, and not as now carried on by individual arrangement.

Findlay, O., Charles Shirtliff, health officer. 1. (a) Have none; (b) ditto; (c) they have it hauled to city crematory; (d) hauled to crematory; (e) about 60 vaults empty into sewers running into river in heart of city. 2. No. (a) Crematory; (b) no; (c) crematory; about $1,400 per year. 3. Both. 4. Barrels in wagons. 6. About 16 yards street garbage and 30 barrels night-soil. 7. Can't say. 8. Yes. 9. None. 10. One mile east of city. 11. No. 12. Hired. 13. By the city's having horses and wagons paid by city to collect garbage.

Hartford, Conn., W. N. Knight, clerk of the board of health. 1. (a) For filling out of city; (b) used for filling; (c) garbage carted out of city and used as fertilizers; others are collected separately; (d) ditto; (e) carried out of city for fertilizers. 2. No. (a) None. 3. Public. 4. Large wooden boxes on wagon. 5. Garbage collected by contract, $7,000. 7. Don't know. 9. Can't tell. 10. Outside of city. 11. No. 12. Hired. 13. Can't tell. Ashes are collected weekly by hired men, horses, and carts. Garbage, etc., collected tri-weekly by contract.

Kalamazoo, Mich., C. Van Zwaluwenburg, M. D., health officer. 1. (a) City gathers, and uses for filling low places; (b) used for filling and private roads; (c) all inoffensive is used for filling; others taken out of town; (d) swill used for hogs of town; (e) farmers use as manure or cover on farms. 2. (a) No; (b) no; (c) hire one team besides the two regular. 3. City only gathers from streets and alleys. Other is private. 4. Some closed; some opened. 5. Not known. 8. Yes. 9. Nothing sold. Swill is used for hogs. 10. Owners of hogs gather. 11. Swill is left on persons' hands too long. People need urging to keep clean. Alleys left in bad condition. 12. Commissioner on streets hires wagon and men mentioned above. No others. 13. The city should do all the work.

Lawrence, Mass., William L. Reed, clerk. 1. (a) Street department; deposited on vacant land; (b) deposited on vacant land; (c) ditto; (d) ashes same as (b); swill sold by contract; (e) part into sewers. Merrimack river. Part in vaults removed by odorless excavation, and by pitting, and by taking into country. 2. Yes, about $3,000. (a) None; (b) 18 horses, 7 ashes-, 3 swill-, and 5 night-soil-carts; (c) $25,000 per year. 3. Public. 4. Covered 18 inches (cubic). 7. 2 cubic inches per man per year. 8. Yes. 9. Swill sold by contract $2.60 per cord, delivered by us to the swill-house. 10. Sold to farmers. 11. Yes. Garbage on dumps creates smell and disease. Everything should be cremated. 12. Hired. 13. By burning waste matter.

Manchester, N. H., Joseph B. Sawyer, member of board of health. 1. (a) Done by highway department; used for filling streets; (b) carried away by highway department; used for filling; (c) waste paper and rubbish (dry) is removed with the ashes; (d) water closets are connected with the sewers which empty into the Merrimack river. Contents of privy vaults are carried away to the farms in the suburbs of the city by two licensed parties. They get their pay from the owners of the vaults and farms. The contract price for removing swill, including all the more perishable material, such as worthless fruit, vegetables, and animal substances, is this year $1,900; last year it was $4,900. The work is done in a manner only passably well. He carries the stuff more than two miles into the country, and dumps it in a hog pasture. It is well away from other people, and his place has not as yet been complained of. This is his first year. 2. (a) None; (b) not known; (c) not known. 4. Ashes, street-sweepings, and dry rubbish on dump-carts. Swill in closed four-wheeled wagons. Night-soil in closed tubs and air-tight tanks. 5. Not known. 9. Only the swill and night-soil, and of these the value is small. 11. The city dumps are usually offensive, owing to the decay of the rubbish. There are occasional complaints of the dumping of night-soil in the city suburbs. 12. The board of health licenses the vault-cleaners. The superintendent of streets hires his men, who remove ashes and rubbish. The mayor and aldermen let out the swill contract. 13. By putting the whole, except perhaps the street cleaning, into the hands of the board of health. We think also by burning all except the night-soil in a furnace.

Milwaukee, Wis., U. O. B. Wingate, M. D., commissioner of health. 1. (a Kept separate from other garbage, and used for filling; (b) ditto; (c) Merz system has been employed; (e) removed by scavengers to adjoining farm lands. 2. (a) No; (b) employed by city; (c) $15,500 last year. 3. City. 4. Wooden wagons. 5. Do n't know. 6. 50 tons. 8. Yes. 10. Out of city. 11. Yes. 12. City. 13. See letter.

New Orleans, La., Lucien F. Saloman, M. D., secretary of board of health. 1. (a) Dumped into Misissippi river below the city; (b) ditto: (c) ditto; (d) ditto; (e) ditto. 2. (a) None; (b) ditto. 3. Public expense. 4. Carts. 8. Yes. 10. Mississippi. 12. Hired by the government. 13. By the cremation of garbage and the sewerage of night-soil.

New York, W. A. Ewing, M. D., sanitary superintendent. 1. (a) Used as filling vacant lots and behind bulkheads in suitable localities, also dumped at sea; (b) ditto; (c) ditto; (e) run into sewers, North and East rivers. 2. (a) None; (b) none; (c) none. 3. Public. 4. Carts, covered with canvas. 5. Do not know. 6. Do not know. 8. No. 9. Not sold. 12. By street-cleaning department. 13. By cremation.

Omaha, Neb., Clarke Gapen, commissioner of health. 1. (a) Dumped into lowlands and river; (b) ditto; (c) dumped into Missouri river; (d) mainly the same; (e) into the Missouri river. 2. No. (a) None; (b) none. 3. Private. 4. Various kinds. 8. Yes. 9. None. 10. Missouri river. 11. The delays and difficulties of removal. 12. Licensed. 13. By the city owning its own teams and removing the garbage itself under the direction of the health department, and the cutting off of councilmen's meddling in such matters.

Pittsburgh, Crosby Gray, chief clerk of the department of public safety. 1. (a) Used for filling streets and low grounds; (b) ditto; (c) ditto; (d) a portion is removed to the country and used for feeding swine, a portion—together with that gathered from residences—is taken to the garbage furnace, balance is mostly deposited in rivers, etc.; (e) many of the privies and water-closets are connected with sewers, which discharge into the rivers, the balance are emptied by night-soilers, who deposit the contents in the rivers. 2. (a) $3,500; (b) no; (c) including salaries, repairs, running expenses, etc., during 1890, about $12,000. 3. Private expense. 4. Wooden boxes, wagons, and carts. 8. No. 11. Great nuisance, arising from deposits at places other than furnace. 12. Six men, at garbage furnace. 13. By compulsory collection, removal, and disposal under contract, at public expense; or by the city owning the appliances, etc., and doing the work. Collections should be made daily during the heated term, and three times per week during the balance of the year, removal to be made by means of air-tight iron boxes or tanks.

Portland, Me., Geo. C. Burgess, secretary of board of health. 1. (a) Gathered by street department; (b) disposed of by householders, etc., themselves; (c) owners must dispose of it themselves; (d) sold to milkmen and others to feed swine; (e) sewers empty into tide-water; night-soil from privies taken out of the city. 2. No; the work is done by contract; $350 per month for collecting house and fish offal. 3. At private expense. 4. Water-tight covered carts. 5. About $81.81 per mile per annum. 6. Average about 15 loads. 7. More than twice as much. 9. The garbage is all fed to swine. 10. Out of city. 11. The work is not done under any proper supervision, and complaint is made both as to its collection and disposal. 12. By the contractors. 13. By placing it, with full power, in the hands of the board of health.

Quincy, Ill., W. K. Haselwood, secretary of board of health. 1. (a) Dumped in out-of-way, low places; (b) ditto; (c) ditto; (d) garbage part sent to city dump in river, below city; (e) part runs into sewers emptying into Mississippi river, balance hauled in tight carts to city dumps; work done at night. 2. No; (a) none; (b) private enterprise; (c) contract from May 15 to Oct. 1, $165 per month. 3. Public. 4. Tight box-wagon, also wagons with tight barrels. 6. An average of eight 2-horse loads. 8. Yes. 9. None sold. 10. City dump in Mississippi river, at lower southern extremity of city. 11. None. 12. Contract let to lowest bidder. 13. Only one third of the city is in the scavenger district, and the service might be improved by including the whole city. We are extending our sewer system service, which is a great help.

Richmond, Ind., Jas. F. Hibberd, county health officer. 1. (a) Dumped into ravines; (b) ditto; (c) ditto; (d) removed by contract; (e) largely into sewers; and thence into river; remainder by night-carts into the country. 2. No. (a) No; (b) used by contract. 3. Public. 4. Tight wooden wagons. 5. $1,815 per year. 6. No data available. 8. Yes. 9. Nothing sold; much taken by private parties to feed hogs; remainder removed by contractor. 10. Farms in the country. 11. Some complaints have been made, by neighbors of hog feeders, of noisome odors. 12. By contract. 13. By the cremation of all offal not fit for fertilizers. This service in the city is not under my personal management, but I am fairly familiar with the details of the work. Our city has a population of 16,608, is situated on a plain 60 to 80 feet above the bed of the river, which runs in a comparatively narrow channel, with their rocky banks. It is maintained in a good sanitary condition by a live city board of health.

San Francisco, Cal., J. Haesch, secretary of board of health. 1. (a) Public dump scavengers; (b) ditto; (c) ditto; (d) scavengers; (e) bay of San Francisco. 2. No. (a) No; (b) no; (c) don't know. 3. Private. 4. Carts, 2- and 4-wheel, covered. 6. Yes, and weekly. 8. Yes. 9. None. 10. Public dump, lowlands. 11. Yes, and had to be covered. 12. Hired. 13. By burning.

Springfield, Mass., I. Kimbal, secretary of board of health. 1. Carried to city farm; fed to swine in part, balance used as fertilizers. (a) Carried away for fertilizing; (b) dumped on the bank of the river; (c) carried away and worked over for manure; (d) included in garbage; (e) from vaults carried to surrounding farms. 2. Does not. (a) None; (b) for garbage only; (c) for garbage only, $7,000. 3. Public. 4. Covered. 5. Cannot say. 6. Estimated ten tons. 10. City farm. 11. To some extent; mostly the foul air which arises. 12. Hired. 13. That is what we are looking for some one to solve.

St. Joseph, Mo., Logan P. Currin, clerk of board of health. 1. Hauled to Missouri river in closed wagons. (a) Revolving broom, attached to common wagon; (b) thrown into Missouri river; (c) ditto; (d) ditto; (e) ditto. 2. No; owned by private individuals. 3. Private. 4. Closed wagon. 5. Do not know. 8. Yes. 9. Dead stock is rendered by factories. 10. Into river. 12. By health officer; paid by private individuals. 13. No improvements at present.

St. Paul, Minn., Oct. 19, 1891. Report of Henry F. Hoyt, commissioner of health. 1. Merz. (a) Filling vacant lots that are below grade; (b) ditto; (c) ditto; (d) Merz; (e) sewers, which empty into Mississippi river. 2. No; private company,—cannot say. (a) Merz reduction works; (c) city pays $15,000 per annum. 3. Public. 4. One-horse, covered wagon. 5. Cannot say. 6. 20 to 25 tons. 7. One pound per day. 8. Yes. 9. Only garbage containing grease is valuable; sold as fertilizers and grease. 10. In the city limits. 11. None that I consider serious. 12. Hired. 13. By a more thorough education of the masses upon sanitation.

Toledo, O., Albert W. Fisher, health officer. 1. Buried. (a) Collected by the street commissioner and buried; (b) ditto; (c) collected by the street commissioner; (d) removed from city; (e) into the Maumee river. 2. No. (a) For dead animals; (b) 12 horses, 8 wagons; (c) private contractor. 3. Contractor receives $10,000 per year. 4. Closed wagons, water tight, 6. 16 loads. 8. Refuse matter and garbage are placed in boxes and barrels, etc., placed in alley, or convenient to garbage collector. 9. Not used; burned, or ploughed under. 10. Beyond city limits. 11. No. 12. Hired by contractor (men *not reliable)*. 13. I favor the city doing this business under the care, direction, and supervision of the H. O. and S. policeman; also favor a crematory. The present system will soon create a nuisance.

Wilmington, Del., W. C. R. Colquhoun, secretary. (a) Collected by contract and hauled to dump; (b) collected by contract; filling up streets; (c) garbage hauled to piggery; (d) ditto; (e) some is run into creek leading into Delaware river. 2. No. (a) No; (b) no; (c) no. 3. Public. 4. In water-tight, square wagons. 6. 75 tons in summer, 6 months; 50 tons, 6 months, winter. 7. Population, estimated 64,000; 31 pounds to each inhabitant per day. 8. Yes. 10. Piggery two miles from the city. 11. Much complaint is made against the contractor's neglecting to collect. 12. Contract. 13. Hard question. Hope you can adopt some plan. I have no suggestion.

Yonkers, N. Y., Valentine Brown, health officer, 1. Used for fertilizing. (a) Used to fill in low ground; (b) ditto; (c) ditto; (d) ditto; (e) into Hudson river. 2. No work done by contract system. (a) No cremation; (c) removing from city proper 12,000. 3. Public expense, 4. 80 covered wagons. 5. Cannot say. 6. 18 yards. 7. At least 19 per day. 9. Not sold. 10. Farms. 11. Yes; from leaking carts, and dumping garbage mixed with ashes; in making new land, etc. 12. Hired. 13. By collecting in water-tight vessels and then cremating.

"E."

THE MERZ OR VIENNA SYSTEM.

By EDWARD CLARK, M. D.,
Buffalo, N. Y.

"The Merz" or "Vienna" system, as it is sometimes called, for the disposal of garbage and refuse, is in use in six or seven cities of the United States. By this method the garbage is not cremated, as has been erroneously supposed by many, but is subjected to a process more nearly akin to desiccation. The garbage and refuse, when first received, is placed in closed retorts or dryers, where it is subjected for some hours to a high temperature, by means of which it is completely dried. This dried residue is afterwards treated by means of a chemical solution which extracts all of the oils therein contained. This, in brief, is the entire process, but a more detailed explanation of the works and the machinery employed will be necessary in order fully to understand just how the work is done.

By means of a runway or elevator, the garbage wagons are taken to the second or receiving-floor of the building, and at once the garbage enters tightly closed receivers, from them it passes down through hermetically closed chutes into what are known as the dryers, which are placed horizontally just below the receiving-floor. These dryers consist of concentric cylinders, one within the other. The inner cylinder receives the garbage and refuse by means of the chutes from the receiver, as above stated, and in its interior is a steel reel provided with innumerable square arms connected on top, which, during the process of drying, is continually revolving in the longitudinal axis of the dryer. The outer cylinder is nothing more nor less than a jacket for the inner one, and is covered with Asbestos for the purpose of retaining the heat. Between the two cylinders is a chamber into which superheated steam is admitted at a temperature of about 300° F. Each dryer holds about three tons of garbage, and after being filled and closed the steam is turned on, and six hours occupied in the drying process. During this interval it is stated that the garbage loses about sixty per cent. of its weight, and becomes thoroughly dry. This large percentage of weight passes off in the form of watery vapor through combination condensers so constructed as to destroy all gases that will yield to water or fire, as well as those requiring both elements for complete destruction, and thence directly into the sewer. The dryers are emptied by means of steam-tight doors in the bottom of the cylinder, and their contents are carried at once by means of conveyors to the extractors.

"The extractors are square upright tanks with a false bottom," in which for a period of six hours the product of the dryers is subjected to the action of a chemical solution, benzine being most generally used, and "by means of which the oily constituents are wholly removed." The benzine is then recovered, and the dry residue is removed from the extractor. Dead animals are treated in separate dryers, which are precisely similar to those used for garbage, except that they have a special connecting pipe for filling. They are treated in the same manner, and subjected to the same process in the dryers as is the garbage.

Prof. Wm. M. Chauvenet, of St. Louis, has given much thought and attention to this matter, and in an exhaustive, able, and impartial report made to the council of that city, under date of December 10, 1890, after being directed by that body to visit and investigate the Merz plants in operation at St. Paul, Milwaukee, Chicago, Detroit, and Buffalo, says of the chemistry of the process,—

"The question as to what takes place in this drying process is perhaps difficult to answer, theoretically, and would demand the most exhaustive chemical analysis to determine. Practically, the results are easy of explanation.

"As long as vegetable organic matter retains its water of composition, it undergoes continual change and decomposition when exposed to the air, during which its malignant gases are set free and given off. The Merz system drives off all water of composition and all moisture in a closed retort, protected from the air and at a high temperature; alters and fixes the decomposable acids, and delivers a product no longer subject to decomposition, even upon long standing.

"The first question asked in regard to the Merz process, even by those who visit the plant, is, What becomes of the gases given off from the dryers during the process of drying garbage?

"After visiting three Merz plants in active operation, and after long discussion of the matter with other chemists, I am of the opinion that there is little or no gas given off in the process of drying, since I do not think the temperature within high enough to decompose vegetable fibre.

"In regard to this temperature there has been some question in my mind throughout. The figure (350° F.) given us at the various plants was not the result of direct measurement in any instance, since this is a difficult question to determine, but since lard oil will begin to smoke and decompose at a temperature of 350° in air, and since no such decomposition of the animal fats in the dryer takes place in any large degree, I think we are safe in concluding that the temperature of 300° F., is nearer the truth. The very dark color of the fatty oil as it comes from the extractor is doubtless due to a slight carbonization or burning, but it must be very slight.

"This conclusion has nothing to do with the sanitary nature of the process, except in so far as it shows that there are probably no burning greases and gases of decomposition to escape from the works; and that, therefore, it is not a surprise that they do not come through the condenser, which I think they would do if generated.

"We have had no time to make the chemical tests which would determine these questions, but, as I have above said, it is of no practical importance under the circumstances. Our investigation must lie wholly with the sanitary nature of the process."

Of the plants in operation in different cities visited, he speaks as follows:

"On approaching the works in St. Paul, no odor was perceptible outside the building, excepting a faint smell of crude petroleum used for running the engines, and which is stored in tanks some distance in the rear of the works. In the delivery-room, where garbage was being unloaded and where several dead horses were being treated at the time, the smell was offensive. In that part of the works devoted to the process of drying and extracting there was no offensive odor whatever, other than a faint smell of benzine.

"The establishment, as a whole, was far less offensive than a soap-factory, and had none of the disgusting features of a rendering-works. After the garbage and animal matter is once in the dryers (and it goes there at once) there is no possibility of offence whatever, even to the most squeamish nostril, and were it not for the pile of garbage, and the animals on the delivery-floor above, the works would be as free from offence as a linseed oil factory. That they are not so is entirely due to the crude way in which the garbage is delivered from carts, out of which it is shovelled upon a floor instead of into hoppers direct.

"The dried residue, before the extraction of the oil, has a faint oily smell; after the extraction, as it lies in the warehouse, it is as inoffensive as garden loam, which it much resembles, and can be handled with impunity, since it is odorless.

"In the St. Paul warehouse was a pile of this product which had been exposed to the air for some five months, which showed no evidence of decomposition, and was as wholly inoffensive as when made.

"The Milwaukee plant has a capacity of forty tons, and is located in the heart of the city. We found this plant treating from thirty-five to fifty tons a day. Outside of the factory there was no offensive smell to indicate what was going on within. The garbage was being delivered in quantity, and in the delivery-room the smells were very offensive. The machinery was running in an orderly manner, and that part of the factory given up to the process proper was inoffensive, and smelled only of benzine.

"There are thirty-nine wagons delivering garbage in Milwaukee, and the shovelling system in use strikes one as slovenly and unclean. The product, which was stored in an open shed, was totally inoffensive after six months' storage.

"The forty-ton plant was not in operation at Chicago.

"In the Detroit plant the delivery-room was open to the same objections as those of the works above described, and the garbage, shovelled from box-wagons upon a wooden floor raised above the street, with its wide doors open to the air, was the cause of much complaint. The condensing engine in this plant was an experiment and a failure, giving rise to a sour smell, due to escaping gases of an acetic nature—a fault not existing at other plants.

"The Buffalo plant was not in operation, and was not visited."

As regards the question of bad odors and nuisance in connection with this method, the report speaks as follows:

"It is my opinion that the odors existing within the works of the various plants were wholly from the freshly delivered garbage lying upon the floor, and had nothing to do with the process of drying and extracting of the Merz process, which is inoffensive from its nature.

"The plants in Chicago, St. Paul, Milwaukee, and Detroit are badly located. It is not surprising that there should be complaints, which there certainly have been, in view of the present methods of delivering the garbage.

"These complaints have in all instances come from those living close to the works, and were due not so much to the process of conversion as to the unclean method of delivery and the congregation of so many garbage-carts in one locality.

"As to the process in the works themselves, we did not hear one complaint throughout our trip."

Prof. Chauvenet concludes his report of investigation and study of the Merz system as follows:

"In reviewing, then, the many interviews and debates in regard to the Merz system, continuing through many days, I find the representatives of the several communities in which the Merz plants have been in operation universally in favor of its introduction. My own investigation, both sanitary and chemical, leads me to the following conclusions:

"1st. That the Merz system, from a chemical stand-point, is an ingenious and perfectly rational process.

"2nd. That it is a perfectly inoffensive and sanitary process for the conversion of offensive animal and vegetable refuse into an odorless and inoffensive product.

"3rd. That the complaints against the system are wholly due to the method of handling and delivering the garbage, for which the Merz system is in no way responsible.

"4th. That with proper methods of collection, proper steel dump-wagons, and properly arranged hoppers for the reception of the refuse, the Merz system will be perfectly free from objectionable features.

"We are told that at Paterson, N. J., the improvements in delivery and the arrangement of hoppers are complete."

The report from which the above quotations are taken was made to the council of St. Louis under date of December 10, 1890.

"F."

THE RIDER GARBAGE FURNACE.

BY CROSBY GRAY,
CHIEF CLERK DEPARTMENT OF PUBLIC SAFETY,
Pittsburgh, Pa.

Before entering upon a description of the furnace, a brief reference to the conditions and events which led to its adoption in this city may not be out of place.

In common with most other communities, Pittsburgh has long wrestled with that all important question, "How can the garbage and refuse be best disposed of?" The sanitary authorities, of course being most directly interested in the subject, gave it the greatest amount of attention, and devoted many anxious hours to its consideration. Several projects were formulated, which were intended and expected to solve the question, but each in turn failed on account of the lack of moral and financial support expected from the legislative branch of the city government and from the public.

The question of the proper collection and removal of this material seemed to be a simple problem under the law, provided the necessary funds were available, but even this was found to be wanting. The most important and decidedly knotty phase of the subject, however, was,—given the funds and appliances necessary to the collection, where, and in what manner, could it and must it finally be disposed of?

The peculiar topography and surroundings of the city of Pittsburgh made this a question of unusual consequence. The city itself being composed of a succession of hills and valleys, and surrounded on almost all sides by hills, made the transportation of such material out of the city, by the ordinary methods, much more expensive than in many, if not most other, localities. Carriage by water was considered as being almost out of the question, on account of the variable stage of water in the rivers, and their being often closed by ice during the winter season.

In 1881 the board of health concluded to make a supreme effort to accomplish the end in view, and advertised for proposals for the collection and removal of ashes and garbage, as authorized under the provisions of an act of assembly, passed in 1872, as follows:

"SEC. 33. The board of health[1] are hereby authorized to employ, from time to time, as many scavengers as they may deem necessary, upon such terms and with such appliances and conveyances as they may deem expedient; and to make, from time to time, such rules and regulations for the conduct of such scavengers as they may deem necessary."

Very complete and elaborate specifications were prepared, which provided for the collection and removal of garbage from residences, hotels, restaurants, etc., daily during the months of June, July, August, and September; three times per week during the months of April, May, October, and November; and twice per week during December, January, February, and March. Ashes were to be collected once per week during the months of May, June, July, August, and September, and twice per week during October, November, December, January, February, March, and April. Ashes and garbage were to be kept separate, in water-tight vessels not larger than a half barrel. Garbage was to be removed to a point or points outside the city limits, and disposed of in such manner as might be decided upon by the contractors. Ashes were to be used for the filling of streets, sunken lots, etc., as might be designated from time to time by the proper city authorities.

Proposals were received in response to said advertisement, and the contract awarded to the lowest bidder for the sum of $24,379 per annum. Unfortunately city councils refused to make the necessary appropriation for carrying out the contract, in consequence of which it was declared null and void.

The subject still continued to agitate the minds of the sanitary authorities, in proportion as the necessities of the case grew; which growth was commensurate with the rapid increase of population.

Not until the early part of 1887, however, did any method present itself which appeared likely to bring the coveted relief. The discovery of "natural gas" in this vicinity, and its adaptability as a good and cheap fuel, induced the authorities to view it as a possibly valuable factor in solving the garbage problem. This was further induced by the favorable experiments made on this line by the city of Wheeling, West Virginia.

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[1] Under the provisions of the "New Charter" of the city of Pittsburgh, which went into effect on February 1, 1888, the board of health was abolished, and all its power and authority vested in, and transferred to, the department of public safety and bureau of health.

At a meeting of the board of health, held January 7, 1887, the following resolution, passed in councils December 27, 1886, was received:

"*Resolved*, That the board of health be, and they hereby are, requested to report to councils a method of removing refuse and garbage from the city, on account of the difficulty arising from the burning of said material in stoves and ranges in which 'natural gas' is used as fuel."

In response to the above request, the board prepared, and submitted to councils at their next meeting, the following reply:

"*To the select and common councils of the city of Pittsburgh:*

Gentlemen: In response to your resolution of December 27, the board of health respectfully report that, after careful consideration of the subject, they are of the opinion that the most economical and satisfactory method of disposal of garbage and butcher's offal is its destruction by fire. This, in our opinion, can best be accomplished by the construction of furnaces for that purpose in different parts of the city, and by using natural gas as a fuel. When this has been done, the persons engaged in the business of removing said material from dwellings, etc., should be required to do so under certain restrictions,—among others, that it be deposited in said furnaces.

"We are of the opinion that suitable plants can be erected at a cost ranging from $1,600 to $2,000 each.

"For the purpose of carrying said project into effect, we would respectfully ask your honorable bodies to make a special appropriation of $7,000, a portion of the same to be expended in the erection of one or two experimental furnaces, which, if they prove successful, should be supplemented by others out of the balance remaining in said appropriation.

Respectfully submitted,

J. C. DUNN, *President*.

J. D. THOMAS, *Secretary*."

In compliance with the foregoing request, city councils did make a special appropriation of the amount mentioned, for the erection of experimental plants.

After further investigations had been made, the board of health, at a meeting held on March 25, authorized and directed the health officer to advertise for proposals for the erection of two "garbage furnaces," in accordance with the requirements of the following general specifications, viz.:

"1. Said furnaces to be erected in such locations in the city of Pittsburgh as may hereafter be designated by the board of health of said city.

"2. Said furnaces to be constructed of such a size and capacity, and upon such a plan, as to fully and completely consume, without any offensive odor arising therefrom during the process of combustion or at any other time, not less than thirty (30) tons each of either garbage, night-soil, or butcher's offal, every twenty-four (24) hours.

"3. Said furnaces to be constructed so that horses and wagons can be conveniently and safely driven upon or over the top, and said wagons unloaded directly into said furnaces; and so that at least four (4) of said wagons can be unloaded at one and the same time.

"4. Said furnaces to be built of first-class material, and in a good and workmanlike manner; and all labor and material used, and all other outlay whatsoever, to be furnished by, and at the sole cost and expense of, the person or persons contracting with the board of health for their erection.

"5. If, upon a thorough and complete trial or test of said furnaces, they do not fully meet the requirements, as specified and agreed upon by the said board and the person or persons contracting to erect the same, of which requirements the said board shall be the sole judge, then neither the board of health nor the city of Pittsburgh is to be held liable for the cost of said furnaces, or any part thereof.

"6. Full and complete plans, drawings, and specifications of said furnaces shall accompany each and every proposal for their erection, the same to be furnished without cost or expense to the said board of health or the city of Pittsburgh.

"7. The board of health reserves the right to reject any or all bids."

In response to said advertisement several proposals were received, and, after careful consideration, a contract was entered into with the "Rider Garbage Furnace Company, Limited," of Pittsburgh, for the erection of one experimental furnace, at a cost of $3,000, to be located at such point as might be designated by city councils or the board of health.

Numerous delays, caused by the difficulties incident to securing a proper site, etc., prevented the completion of the furnace until very late in the following autumn.

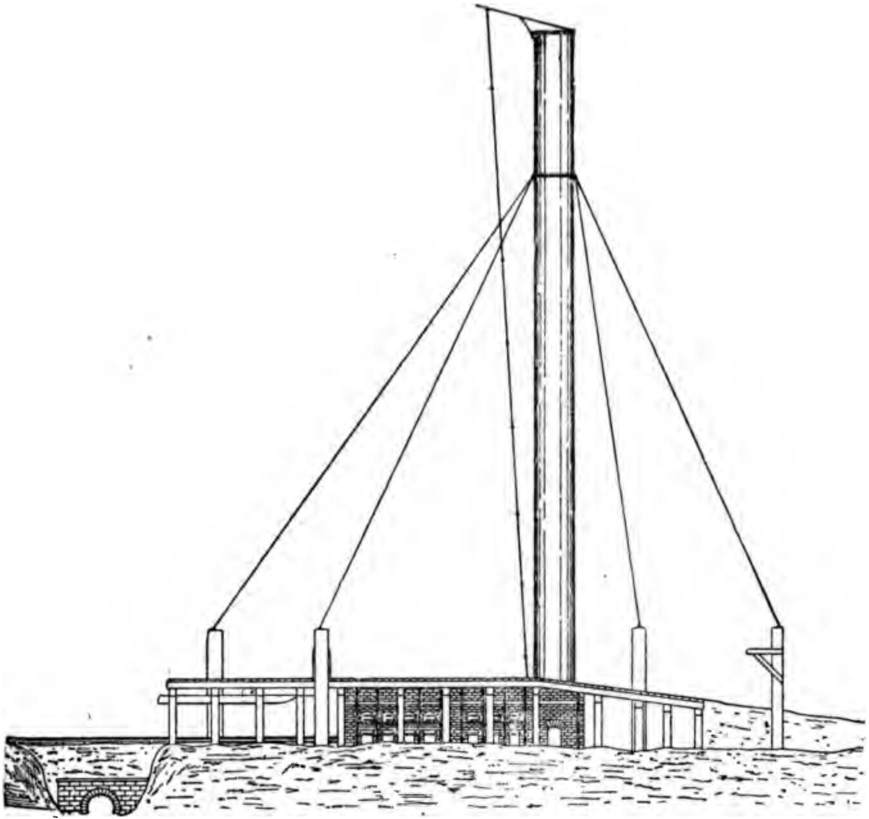
When completed, a number of tests were made, coal being used as fuel, most of which proved to be successful. The tests made in the consumption of garbage were especially so. But one test was made with night-soil, and that only a partial one, on account of the violent opposition of the few residents of the locality to the carriage of the material through their neighborhood, but enough was developed to determine that such material could be destroyed, with probably a few changes in matter of detail. The tests made with butcher's offal were also satisfactory. Owing to the peculiar conformity of the ground upon which it was erected (a steep hillside) the third specification was so modified as to permit, or require, the unloading of but two wagons at the same time, and they only from one side of the furnace. The supply of garbage being so variable, it became necessary to provide a receptacle or tank at one side of the furnace into which the material should be dumped from the wagons. This was constructed of boiler-iron, with a perforated bottom through which much of the fluid matter was conveyed into a sewer by means of pipes or spouts. A shed was also constructed, in order to protect the furnace and employés from the weather. The cost of these two items or additions to the plant, and not provided for in the general specifications, was divided between the city and the contractors, the city's share aggregating $750, thus making the total cost $3,750.

In construction it is an elongated furnace of two chambers, separated by a bridge wall of fire brick three feet in thickness, and having in its upper portion a semi-circular opening to admit draft from chimney and to allow the flame from the front or combustion-chamber to pass freely over the contents, and to heat to an intense degree the roof of the dome, from which heat is radiated to the contents below.

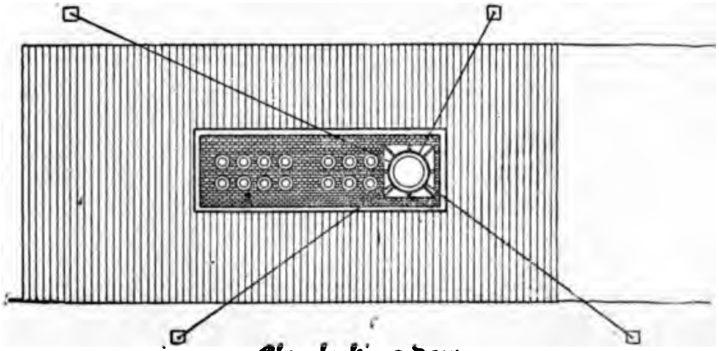
In the dome, or top of the furnace, there are fourteen circular openings, eight in the first chamber and six in the second. These openings are sixteen inches in diameter, and three feet apart on centres, except at the fire wall, which intersects the furnace latitudinally and separates openings at that point by about six feet. The front chamber is about twelve feet long by six and a half feet wide; rear chamber, about ten feet by six and a half feet. The smoke-stack, which rises at

Rider Garbage Furnace

Capacity 30 Tons in 24 Hours



Side Elevation



Plan looking down

end of rear chamber, is eighty feet in height, made from iron plate bolted or riveted in the ordinary way, lined to the top with fire brick four inches in thickness, and has a diameter of four feet in the clear.

The base of the furnace in the front chamber is composed of grate bars set in the fire brick, and in the second chamber, beyond the fire wall, of solid brick.

The first two openings in the front chamber are used for receiving the fuel necessary to properly heat the furnace, supplemented by a small amount, in the shape of wood, used in the second chamber. Before beginning to feed the furnace with garbage it is thus heated to a very high degree.

The foundations of the furnace and stack are built of rubble masonry (laid in lime mortar) 3 feet 6 inches high. The side walls are 24 inches thick; footing course, 8 inches high and 3 feet wide; foundation, under bridge wall, 3 feet thick; under stack, 7 feet 6 inches by 10 feet 6 inches on top, and 8 feet 6 inches by 11 feet 6 inches at base.

All masonry above the floor-level is built of red and fire brick to the dimensions required, the red brick being laid in lime mortar and the fire brick in fire clay. The end and side walls on inside of furnace, from 10 inches below top surface of grate bars and floor of reducing-chamber, also the full depth of jambs and arches of openings, are of fire brick 4½ inches thick. The bridge wall between grate, furnace, and reducing-chamber, also between-reducing chamber and stack, is of fire brick from 10 inches below top of grate bars. The arched roof of furnace is of fire brick, and 9 inches thick. The top of furnace, bottom of reducing-chamber, and ash pit are paved with fire brick laid on edge. Bottom of reducing-chamber is 9 inches thick. The charging-holes through roof are lined at top with cast-iron rings having movable cast-iron covers, which, when in place, are flush with top of furnace. The doors and frames in side walls of furnace and reducing-chamber above the line of grate bars are of cast-iron; frames are set in sill plates, said sill plates being on a level with the top surface of grate bars and projecting 3 inches inside, and to a width equal to the height of rib on buckstave on the outside of furnace. The door frames are held in place by the buckstaves. Each frame has doors swung on hinges, and lined on inside with liners of fire-clay.

The ash-pit openings under grate bars in the side walls are covered on top with cast-iron plates, the full width of wall. The ash-pit doors are of wrought-iron, and have wrought-iron handles. The top edge of side walls and of end wall are protected by a cast-iron plate. The furnace is harnessed with wrought-iron rods and cast-iron buckstaves and plates.

The stack is 80 feet high above top of furnace. The cylindrical part is 75 feet high, and 4 feet 10 inches outside diameter. The base is 5 feet high, and the wrought-iron stack rests on a plate 1¼ inches thick, which is provided with a circular ring for holding same on base where it rests on top of furnace. The stack is lined with fire brick 4½ inches thick, and is stiffened with four 1½- by 2-inch angle irons riveted vertically on inside, and equal distances apart. A 2½- by ½-inch wrought-iron ring is riveted on the outside of top. The stack is held in place by four guy-rods connected about twenty-five feet from the top.

It has been in continuous use since April, 1888, except on two occasions when it became necessary to close it for repairs, principally caused by defective workmanship in its original construction.

During the year 1889, the only one in which an accurate estimate was made of the work performed by the furnace, there was consumed 23,460 cubic yards, or 9,384 tons, making an average of 75 cubic yards or 30 tons per day, at an operating cost of 35.9 cents per yard, or 89.9 cents per ton.

This work was done without offence to either sight or smell, neither odor nor smoke arising from the process of combustion being perceptible. During the busy season it is operated both day and night; six men are employed in its operation, and natural gas is used as fuel.

In the opinion of the writer, the cost of operating is too great, and could be considerably reduced. The enormous advance in the price of natural gas renders its use as a fuel for this purpose entirely too expensive. Coal, coke, or even slack might be substituted to good advantage. The number of employés could also be reduced, by probably one third, without detriment to the service. The method of feeding or charging the furnace is also faulty. At present the material is drawn from the receiving-tank into galvanized iron vessels holding about a barrel, which are conveyed to the charging-holes and the contents deposited in the furnace. This involves too much handling, and adds materially to the expense.

A better device for the purpose would be the placing of the receiving-tank on top of the furnace, with which it should be connected by means of circular conduits, through which the material could be conveyed directly into the charging-holes, thus reducing the cost of handling very considerably.

A Rider furnace has been in successful operation in the neighboring city of Allegheny during the past three years. I am informed by the superintendent of the bureau of health of that city that the cost of this plant, including buildings, approaches, etc., was $5,700. Its estimated capacity is thirty tons per day. Two men, and a portion of the time three, are employed in its operation. It is in use only during the day-time. I am informed that the cost of operating it is about $150 per month.

"G."

THE ENGLE GARBAGE CREMATOR.

By Col. W. F. MORSE,
New York.

The history of the Engle Garbage Cremator, from the time five years ago when the inventor began his experiment to improve upon the old-fashioned way of disposing of the waste organic matter of his own house, down to the present time when the cremator destroys the waste of large cities, is a history of successive stages of experiment and growth.

From the beginning, the absolute and total destruction of worthless and offensive matter was the purpose proposed, and to do this without creating a more objectionable condition of things was the problem. Step by step the apparatus took on a more improved and simplified form, until his invention, the original night-soil destructor, was adopted at several places for the smaller public institutions, where was shown its utility and value.

Then the need of some larger plant for the use of the whole community became evident, and the first garbage cremator was built at Des Moines. This was followed presently by other furnaces, and these in turn by other and larger cremators, until at this time there are nineteen cities and towns using this form of garbage disposal, and others in process of construction.

The leading principle of the Engle device was the burning of the material in such a way as to destroy the fumes or gases of combustion, and utilize these to aid in forming heat for the destruction of the original material, and it was only after repeated efforts and experiments that this was accomplished.

The Engle Garbage Cremator, of whatever size, is a rectangular brick structure with openings on the top for feeding the garbage through, with two fires, one at each end, and a garbage-grate between these sustaining the material to be destroyed in such a way as to cause the smoke and products of the garbage combustion to pass across one or the other of these fires and so destroy the fumes, and use this heated and burning smoke and gas as a fuel.

A cremator of the larger size is 32 feet long, 9 feet wide, and 12 feet high. At one end a brick chimney nine feet square and 75 to 100 feet high, or an iron chimney of 50 to 70 feet on a base of 20 feet.

The top of this furnace has four circular openings, three of 24 inches and one of 34 inches in diameter. There are platforms at the side of these openings allowing a cart to be emptied directly into them, and over all a covering house with sliding doors and iron roof.

Below, on one side and at each end, are two large fire-doors, and along the bottom between these fire-doors are others called ash-pit doors, while above there is a range of smaller round doors through which the garbage is stirred up or stoked.

Half way from the top to the bottom of the interior are set the bars which catch and retain the garbage fed through the circular holes on top. The two fire-boxes at either end inside are on a level with these bars.

Below is a platform or hearth, dished or sloped to the centre, which catches and holds all liquids passed through the feeding-holes and falling through the garbage-bars.

Underneath this again comes a long flue running the whole length of the furnace and going directly into the stack.

There are dampers which control the openings into the chimney and the openings into and out of the combustion-chamber under the bars.

The furnace being charged with garbage, which in this case would be say 15 cubic yards, the fires are lighted, and the flames from the fire nearest the stack, or first fire, pass over and through the garbage, driving the smoke and gases into and across the left hand or second fire, where they are consumed.

The flames from this burning fuel and gas pass down on the left hand or outside this second fire, and are by the action of the draught brought back under the garbage-grate and carried on their way toward the flue into the stack or chimney where discharged.

By an action of this returning fire the liquids received in the shallow pan or depressed hearth under the garbage-grates are evaporated and burned.

By arranging the dampers, the flames from the first fires may be passed across the second fire and under the hearth, insuring the perfect combustion of all vapors from the liquids.

Or, if desired quickly to consume the garbage at a time when the drying action of the first fire has expelled the gases and moisture, then the dampers are so operated as to pass the flames directly into the chimney, but in no case can the smoke or fumes escape without passing across one or the other of these fires.

The ashes as they fall through the garbage-bars are raked out through the lower range of doors, and from time to time, as needed, the garbage is stirred up and distributed over the garbage-grates through the upper range of stoke doors,

The action of the furnace is continuous. The garbage is fed in as needed, with no material loss of heat or escape of flame; the closing of the doors before this is done creates a strong down draught through the feeding-holes. The larger feed-hole receives the body of a horse, though a portion only of this opening is used in usual service.

The garbage-grates being made of pipes, with a circulation of water, there is always steam and hot water for cleansing and disinfecting the pails, barrels, and carts used in the collection service, and for keeping the platforms and surroundings clean.

If desired, there may be a steam boiler for obtaining power attached, so as to be heated by the flames from the furnace.

The construction of the cremator is of the most solid and massive character. To withstand the intense heat required to burn matters containing large amounts of moisture—to burn, in many cases, water itself—to maintain this temperature for weeks or months together without a stop, and to remove the products of combustion with no interference with the work of the furnace, demands a structure which shall be durable, effective, and convenient.

The walls are lined with fire-clay blocks, 12 by 9 by 8 inches, laid close as possible, and backed by a double brick wall. All the openings are protected by solid fire-clay blocks shaped to fit the apertures, no iron except the surface of the garbage-bars being exposed. These blocks are specially made of the most refractory material to be had, and shaped and cast so that they fit accurately together. Outside, the braces, thrust bars, buckstays, and tie-rods hold every part firmly, while the fire-doors are carried on heavy iron panels similar to boiler fronts, the utmost care being taken to make every part as strong as the best brick and iron can be put together.

The capacity of the Engle Cremators, and their consequent cost, have been approximately determined by establishing four sizes adapted to an equivalent number of people, viz.:

No. 1, the smallest public furnace, may be said to be adapted to a town of 2,000 to 3,000 people; No. 2, 3,000 to 5,000; No. 3, 6,000 to 10,000; No. 4, 12,000 to 25,000. It is impossible to give exact figures in this connection, as much depends upon the character and kind of refuse, the amount of liquids, the kind of fuel, and the varying conditions; and for the same reasons it is impossible, in the absence of exact information, to quote exact estimates of cost and maintenance, but an approximation can be arrived at.

A cremator of the largest size will destroy an average of seventy-five cubic yards of the daily miscellaneous garbage and refuse of a city, and may, when occasion requires, consume a much greater amount. The largest quantity destroyed in one day in one furnace of the size No. 4, was 145 cubic yards of garbage and refuse, and the body of a horse.

For cities of the largest size a number of cremators at different points are required,—or, as is sometimes done, two or more burning garbage and night-soil separately are built together, using one chimney, economizing space and expenses of labor.

The cost of maintenance, or running expenses, depends mainly upon the cost and kind of fuel used. Wood, coal, gas, or oil may be used, as is most convenient. The records kept of the quantity of refuse destroyed at various places and the cost of same, give a basis for calculation for use elsewhere.

To destroy seventy-five yards of the ordinary garbage collection of a city will require the labor of three men and the combustion of one to one and a half to two tons of coal, or its equivalent in wood or other fuel. With coal at $2 per ton, the cost per cubic yard for fuel and labor will be about 10 cents, and proportionally higher as the cost of fuel increases. With natural gas the cost falls to 8 cents or even less.

The destruction of night-soil is accomplished by the Engle Cremators. Where the quantities are great, a specially built furnace is best, but where small amounts (from 10 to 30 barrels per day) are involved, it is burned in the same furnace after the combustion of the garbage. The cost of destroying a barrel of night-soil containing from 15 to 45 per cent. of liquid is about the same as for one cubic yard of garbage.

The bodies of animals of whatever size are burned with no interference with the regular work of the cremator. Refuse paper, manufacturing scraps, house-, store-, and shop-sweepings, small fruit cans and meat tins—every worthless and useless combustible waste which fire will affect—are classed as a part of the inorganic waste of a city, and consumed in this furnace. The destruction by this furnace of articles which have been in contact with infectious or contagious diseases, bedding, clothing, furniture, etc., as well as all kinds of hospital waste, without the chance for escape of disease germs, is a means of great service to health officials in stamping out contagious diseases.

The ashes of combustion of garbage (animal and vegetable matters) have a positive value as a fertilizer. While chemical analysis shows the presence of potash and phosphoric acid amounting to 7 to 12 per cent., the practical results of the use of this fertilizer in the hands of farmers is a far more satisfactory test, and has been uniformly successful. There is also a large amount of débris, coarse ashes, tins, iron, crockery, etc., of value for filling low grounds or as foundation for streets.

The cost of construction of these furnaces can only be approximately stated, as without personal investigation there are many conditions which cannot be accurately estimated. But the expense of constructing an Engle Cremator of the smallest size (No. 1), with covering house, platforms, and approaches, completed and in working order, may be stated at $2,500 to $3,000. The larger sizes increase proportionately in price, depending upon location, expense of labor, material, and other considerations.

The Engle Garbage Cremators have been in continuous use at seventeen places since their establishment, where have been constructed twenty-six furnaces of the various sizes.

One of the smallest size is in use for the destruction of infected articles and hospital waste; two of the next size (No. 2) are at U. S. government posts; *fourteen of the size No. 3* have been built, three of which were afterwards replaced by larger ones; and nine of the largest dimensions (No. 4) are now in constant operation.

Four cities erected at the beginning each two furnaces, for garbage and night-soil respectively; and at nine places both night-soil and garbage are destroyed by the same Engle cremator.

"H."

GARBAGE DISPOSAL IN EUROPE.

By RUDOLPH HERING, C. E.,
New York.

As a small contribution to the work of the committee, I append herewith a description of some garbage disposal works which I recently examined at Southampton, England, which are considered not only quite satisfactory, but also economical, in their operation.

I also append a description of the interesting Chelsea works, near London, England, which is copied from the *Engineering Record* of September 19. This description has been prepared from reports made by Sir Douglas Galton, G. R. W. Wheeler, Dr. P. Norman Evans, and others,—the names hardly needing an introduction to American sanitarians.

(a) CHELSEA.

From *Engineering Record*, September 19, 1891.

"The works of the company are at Salopion Wharf, Chelsea, and dispose of a large portion of the refuse of Kensington and Westminster. They have been in operation about two years, and now have a capacity of 35 loads a day. The aim of the inventors of the process, J. C. Stanley and Joseph Russell, has been to utilize every part of the refuse of houses that is of value; and in order to accomplish their purpose the rubbish has to be sorted. This is expensive when done by hand, as is usual in this country, but the Refuse Disposal Co. have adopted a mechanical screening which is reported to be cheap and effectual.

"The dust-carts deliver their loads into a revolving cylinder 10 feet in diameter and 12 feet long. This cylinder is made of iron ribs placed 10 inches apart, upon which are fixed wooden bars, with a clear space of 2½ inches between them, so that anything less than 10 x 2½ inches in size will pass through. The wooden bars are used to keep the bottles that are in the refuse from being brokon. The cylinder rests on friction wheels, and is driven by external gearing. Its axis has a tilt of about nine inches in its length. A worm revolves inside the cylinder and works the refuse along, from two and a half to three minutes being required to pass from the hopper to the outfall.

"The material which does not drop through the meshes of the cylinder is taken out and sorted by hand as it arrives at the farther end. It consists mainly of cardboard, bottles, coal, tin boxes, cloth, and animal and vegetable refuse. The last portion is taken to a mill and ground; the remainder is sorted into separate baskets. The screenings from the first cylinder pass into a second 8 feet in diameter, 16 feet long, and covered with wire-work having 1¼-inch mesh. This cylinder is also supported on friction wheels, is driven by external gearing, and is provided with a central worm to drive along the bodies which do not pass through the meshes.

"The matter that falls from the end of the second cylinder is exposed to a powerful blast of air, which blows the paper from the heavier material into an iron box, where it is subjected to heat from exhaust steam, which is passed through pipes in the chest. The heavier material is raised by an elevator to a slide, placed at such an angle as to regulate its descent to a horizontal iron table, which constantly revolves, and thus passes the material before a number of boys who sort it out. Coal, metals, and boots and shoes are saved, while the nondescript refuse, such as bread, vegetable and animal matter, broken crockery, and the like, is taken to the mill and ground up with the similar refuse from the first cylinder.

"The material which drops through the second cylinder is delivered by an endless band into a third cylinder, also of iron, 6 feet in diameter, 15 feet long, and covered with a wire screen of ⅜-inch and ½-inch mesh. This cylinder is also furnished with a worm. Whatever passes through the former mesh is called breeze, and that which passes through the latter, ashes. The ashes are used to mix with clay for brickmaking, and the breeze is either burnt or pressed into briquettes. Both ashes and breeze pass over a fine shaking screen, which takes out everything below ⅛-inch in size. This is said to be valuable as manure, as it contains the greater part of the animal and vegetable matter ground up in the mill.

"The dust which arises during the operation of the cylinders is removed by a powerful exhaust acting through apertures in the centre of the cylinders, and in other places where the movement of the material generates it. The exhaust carries this light matter into the closed ash pit of a locomotive boiler, of which there are three in the works, all worked by forced draught. The smoke from these boilers, as well as from two others in which the refuse straw is burnt, is driven by an exhaust fan through scrubbers, where it is well washed before passing into the air.

"The paper screenings, after being dried at a high temperature, which can be made high enough to remove any danger of infection if necessary, are sorted and freed from dust, and then pulped for conversion on the premises into brown paper or cardboard.

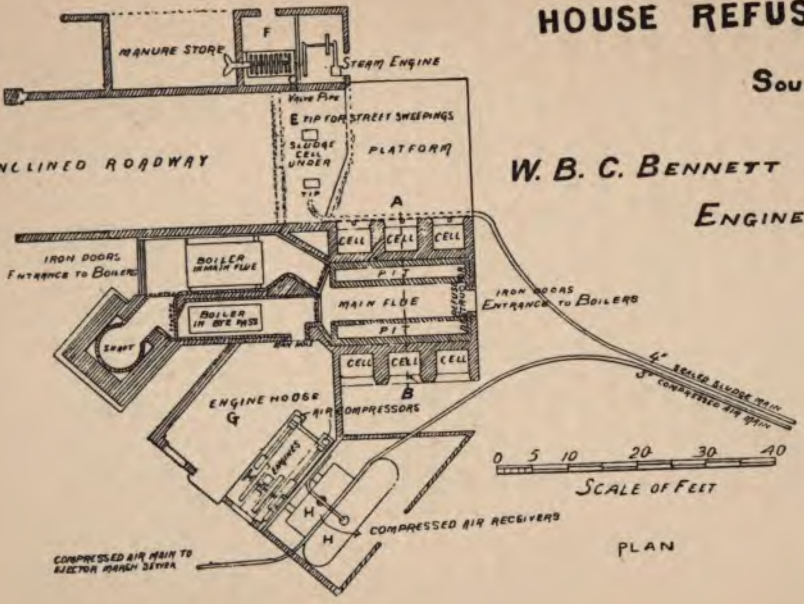
"A series of experiments made by Bryan Donkin & Co., of London, with screened fuel from the disposal works, gave the following evaporative efficiencies of the different classes of material: Refuse through ⅜-inch mesh, 2½ pounds of water per pound of fuel; refuse through ½-inch mesh, 2¾ pounds; briquettes, 3⅘ pounds; coarse breeze, 3¼ pounds. The proportion of incombustible matter was found to be very high, varying from 31 to 36 per cent. According to Dr. Evans, the company manufactures about 15 cwt. of brown paper from refuse per day of 12 hours. He also states that with more space and better sorting and treatment of the materials the value of the output could be considerably increased. As it is, refuse worth from $2.50 to $5 a ton is made into a paper, selling, it is claimed, at from $35 to $40 per ton. The special value of the process is, however, that it enables the paper to be cleaned immediately, instead of being retained until a market can be found for it.

"The great advantage of this method of disposal would seem to lie in the fact

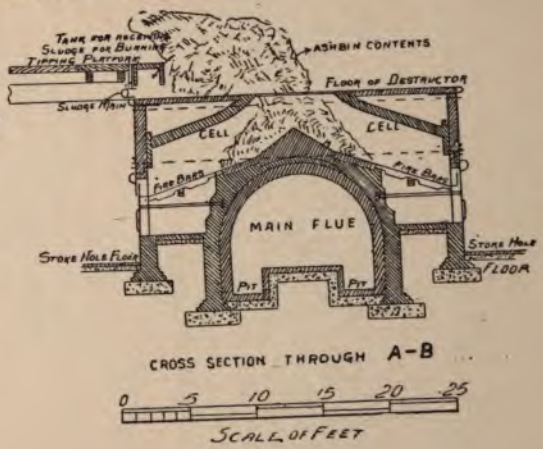
HOUSE REFUSE DISPOSAL WORKS.

SOUTHAMPTON ENG.

W. B. C. BENNETT
ENGINEER



PLAN



CROSS SECTION THROUGH A-B

that it apparently enables a municipality to realize something on its refuse matter instead of heaping it on dumps to become offensive to both eyes and nostrils, or of burning it in crematories at an expense that has been stated by Prof. Baumeister to range from 20 to 37 cents per ton, including interest on the plant."

(*b*) SOUTHAMPTON.

Mr. W. B. G. Bennett, borough engineer of Southampton, was instructed in 1885 by the corporation to devise a scheme for collecting and disposing of the house refuse of the whole town. After studying the available methods, he built works which may be described as follows: The works have been in use for four years. About sixty car-loads of garbage and ashbin contents are daily collected and disposed of. The carts are especially constructed for the purpose. They are of iron, covered, and discharge their contents directly into the cells of the destructor.

The destructor has six cells or furnaces, each capable of burning 8 to 9 tons of garbage per day. They are shaped and arranged as shown on the accompanying sketch. The garbage and ashbin contents are dumped into a feed-hole, and thence pass by gravity into the cells. The material is dried and heated from the main flue, pouring under the feed-hole, and is finally burnt when by its own weight it reaches the fire bars. It is stated that no coal is used in the works, and that the refuse matter, when dried, furnishes sufficient fuel to maintain the process perpetually. The draft is downwards into the main flue, in which are two boilers, for alternate use as shown, built between the destructor and the shaft, which is 160 feet high. One boiler has 30 H. P., and is multi-tubular and made of steel. In a by-pass, a smaller boiler is situated, to be used when the larger one is cleaned. No obnoxious fumes from the combustion are perceived. The steam generated in the boiler drives a pair of engines which compress air into two large receivers, whence it supplies the power for several sewage-pumps. The steam also serves for drawing precipitated sludge through a 4-inch pipe from the sewage-works to the disposal station a mile distant, where it is mixed with the street-sweepings and sold as manure. Sufficient steam is still left to drive machinery for the preparation of horse-fodder at the corporation stables, and an electric light plant to illuminate the station with its stables and dwellings. It is found that 25 tons of refuse, when burnt, generate sufficient steam for all of the above purposes for one day.

The residue from the continuous day and night combustion consists of about 20 per cent. of good, hard clinkers and sharp, fine ashes; the cinders are used for the foundation of roadways and for the manufacture of paving slabs, which are sold at 2s. 6d., or 5s. per square yard when 2½ or 5 inches thick respectively.

The initial cost of the destructor, including engine-house, inclined roadway, chimney shaft, and boiler, was £3,723, or $18,600. The annual cost of burning the refuse is £221, or $1,100. The amount burnt is from 25 to 50 tons per day of 24 hours, or costing at the rate of 14 to 7 cents per ton respectively. Against this cost should be placed the profitable use of the steam for power purposes and for lighting.

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1892
Amer. public health
assoc. Committee on
disposal of waste and
garbage.
Report.

DATE DUE